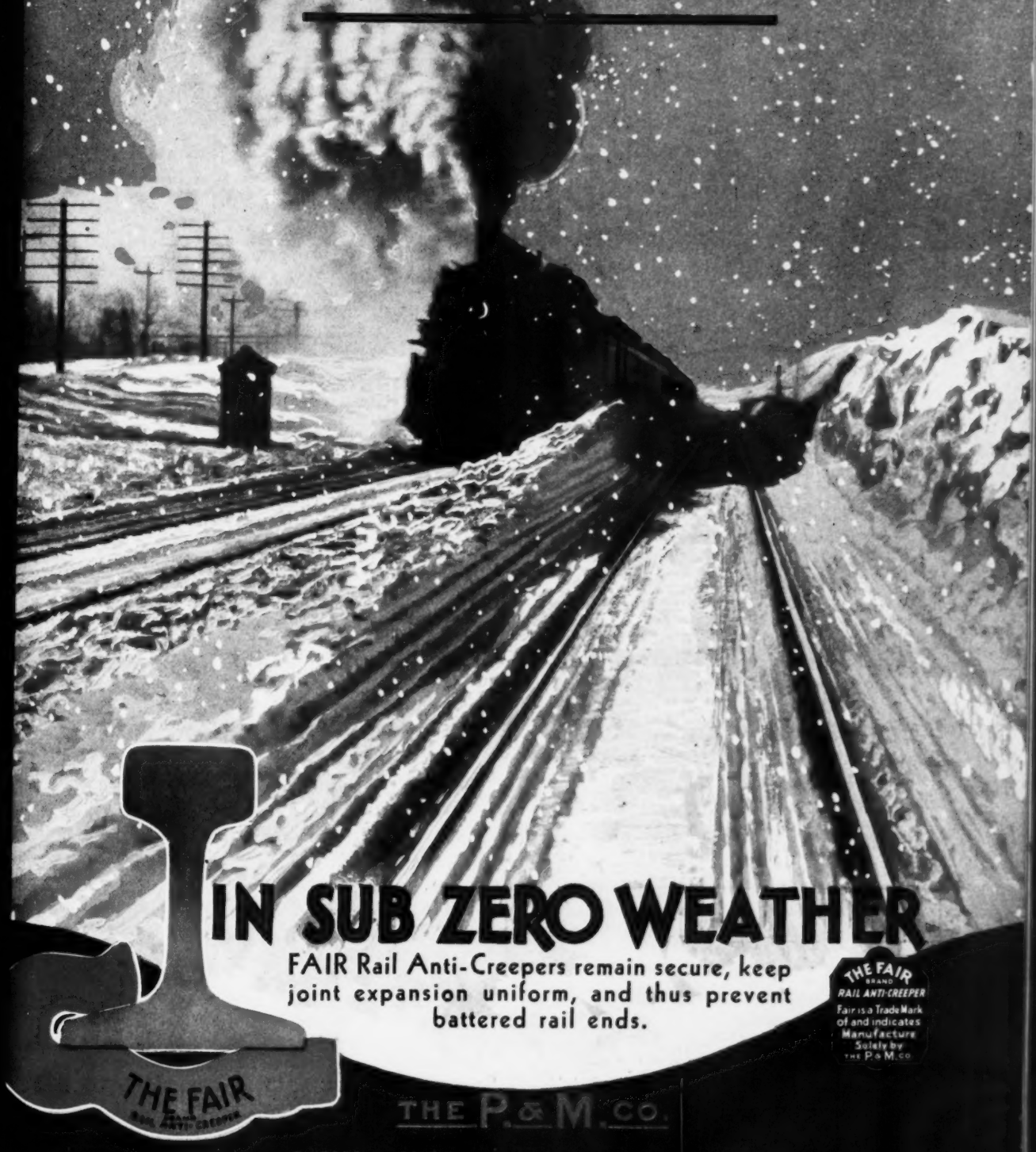
Two Parts
ART ONE

Railway Engineering and Maintenance

January, 1933



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CHICAGO CALCUTTA LONDON SIDNEY NEW YORK

Water Treatment has saved the Railroads *millions*

. . . . says Mr. Aishton

CHEMICAL treatment of locomotive boiler water has saved millions of dollars, said R. H. Aishton, president of the American Railway Association, recently, and—"one road shows a saving of *$1,000,000 annually* due to this alone."

The water used in locomotive boilers totals *350,000,000,000 gallons* per year. The amount of water treated jumped from three billion gallons in 1910 to about 100,000,000,000 gallons in 1930—evidence of a tremendous increase in savings.

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Sodium Aluminate Water Treatment corrects conditions that cause pitting, corrosion and scale. It reduces boiler repairs, cuts fuel consumption, decreases engine failures and lengthens the period between locomotive shoppings.

★ *One railroad effected a saving in the cost of new fireboxes, new side sheets and new back flue sheets of $395,820 for the year 1930, over the year 1926, with Sodium Aluminate Water Treatment.*

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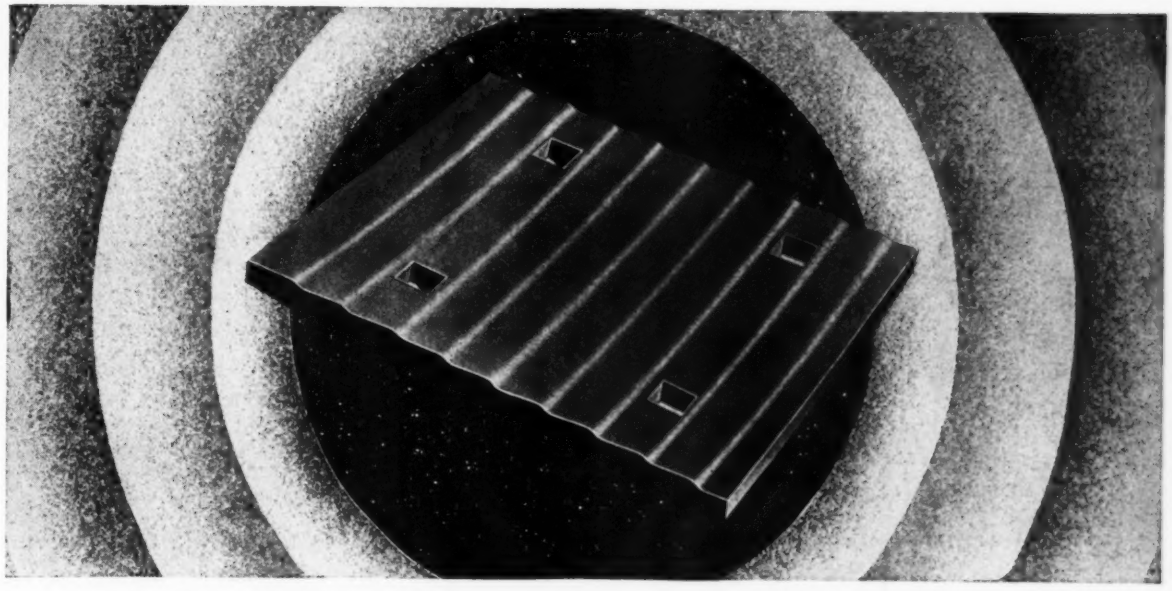
•NALCO SYSTEM

Published monthly by Simmons-Boardman Publishing Co., 105 West Adams St., Chicago, Ill. Entered as second class matter February 14, 1931, at the postoffice at Milwaukee, Wis., under the Act of March 3, 1879. Application pending transfer as second class matter to Chicago, Ill., postoffice with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 West Adams St., Chicago, Ill.



No tie plate offers greater opportunities for immediate savings in lower first cost and for future economies in reduced tie renewals than the LUNDIE PLATE

for 1933 ECONOMIES

Right now when economy is of such vital importance, the Lundie Tie Plate, more than ever, is one of the outstanding factors in reducing the cost of track maintenance . . . The Lundie Plate saves tangible dollars in first cost, because the economical distribution of the metal insures maximum strength at lowest cost. There is no sacrifice in strength—every ounce of metal is made to do full duty . . . in years that follow the

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The Lundie Engineering Corporation

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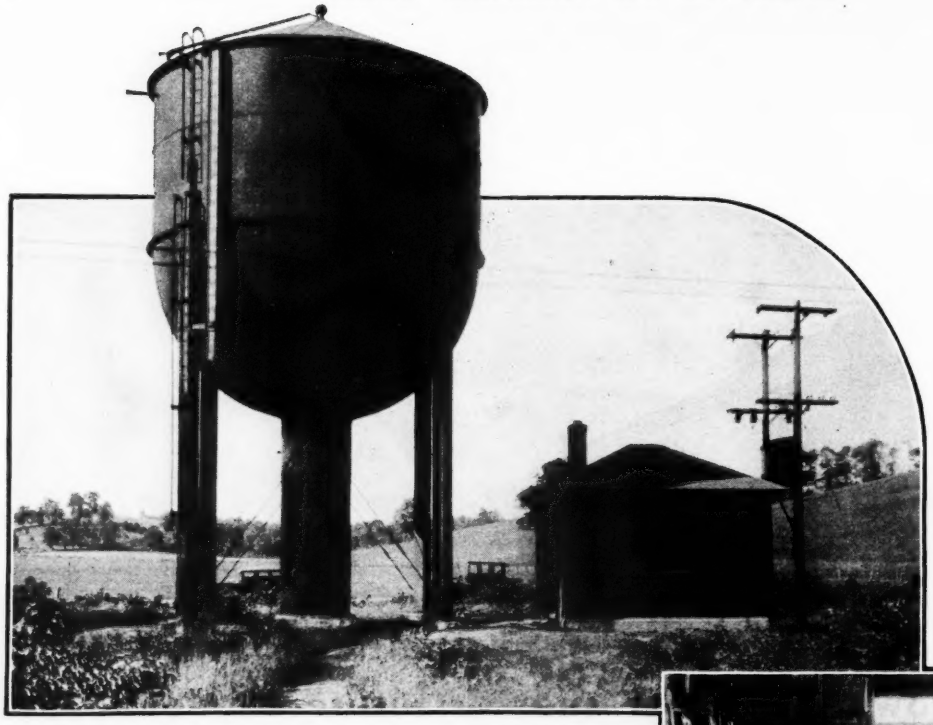

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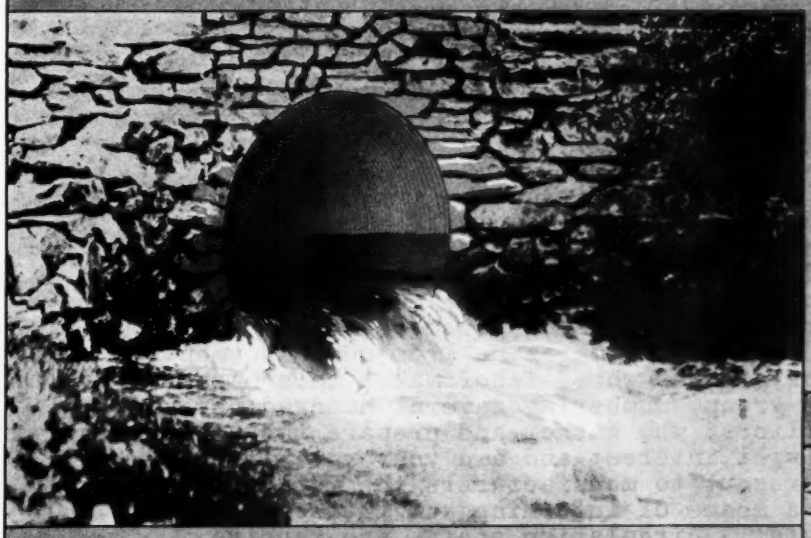

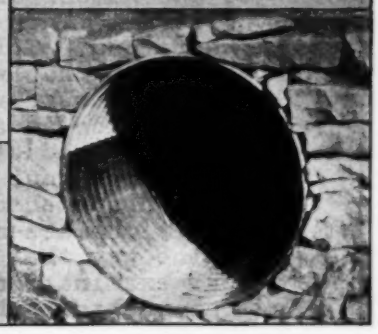

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No. 49 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: A HAPPY NEW YEAR

December 29, 1932

Dear Reader:

Although we realize that by the time this letter reaches you another holiday season will have passed and we will have entered a new year, we, the staff of Railway Engineering and Maintenance, extend to you our greetings, nonetheless sincere and hearty by reason of the delay.

We wonder if you have ever given a thought, as you have read your copy of the magazine from month to month, to the number of persons whose labor makes this magazine possible. This group, numbering several hundred persons, greets you. Editors, who gather and prepare the information that will interest and aid you; advertising salesmen, who present to manufacturers the merits of our publication as a means of informing and interesting you in their products; a circulation staff, who receive and record your subscription and arrange for your copies to be dispatched to you regularly each month; a make-up staff, who assemble and arrange the advertising pages in the way that will be most pleasing and convenient for your examination; engravers, who so prepare the illustrations that they may show most clearly the details of the work or device in which you are interested; printers, whose high-class workmanship makes your reading a pleasure--each in his turn contributing to the production of your magazine.

All of us--one and all--join in wishing you a Happy New Year, with more liberal portions of joy and prosperity than have been the lot of us during the year just closed.

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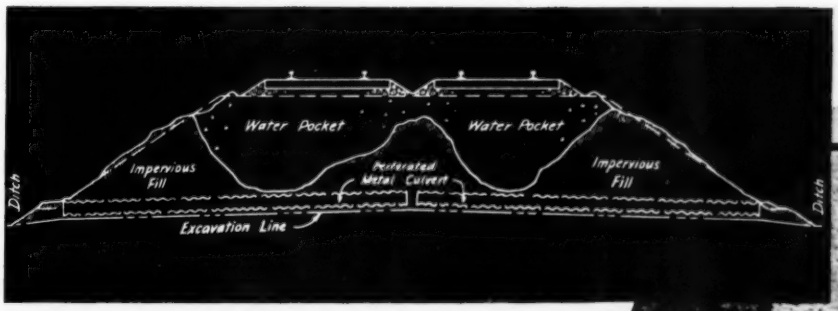
DRAIN WATER POCKETS IN FILLS WITH TONCAN IRON CULVERTS



METHOD OF DRAINING WATER POCKETS IN FILLS . . . By Using Perforated Metal Culvert . . . "One-Man" Riprap as Back-Fill Material . . .

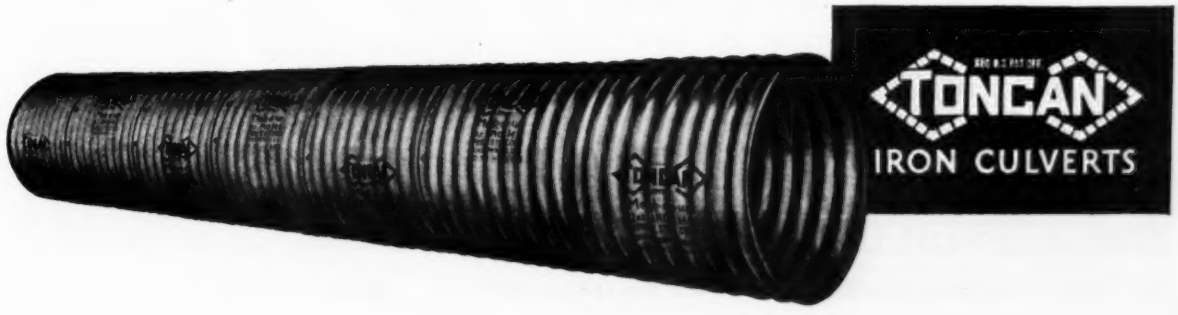
Toncan Iron Culverts play a vital part in the drainage of water pockets in fills—those depressions in the roadbed which, filled with a plastic mass of ballast, earth and water, grow in depth and size under the continual churning of traffic.

The first notice of a water pocket comes when the track needs constant lifting and tamping every few days. Later, bulges appear at the toe of the ballast on the shoulder of the fill. Large pockets containing much water will cause the sides of the fill to cave and slide, and the toe of the fill to creep outward.

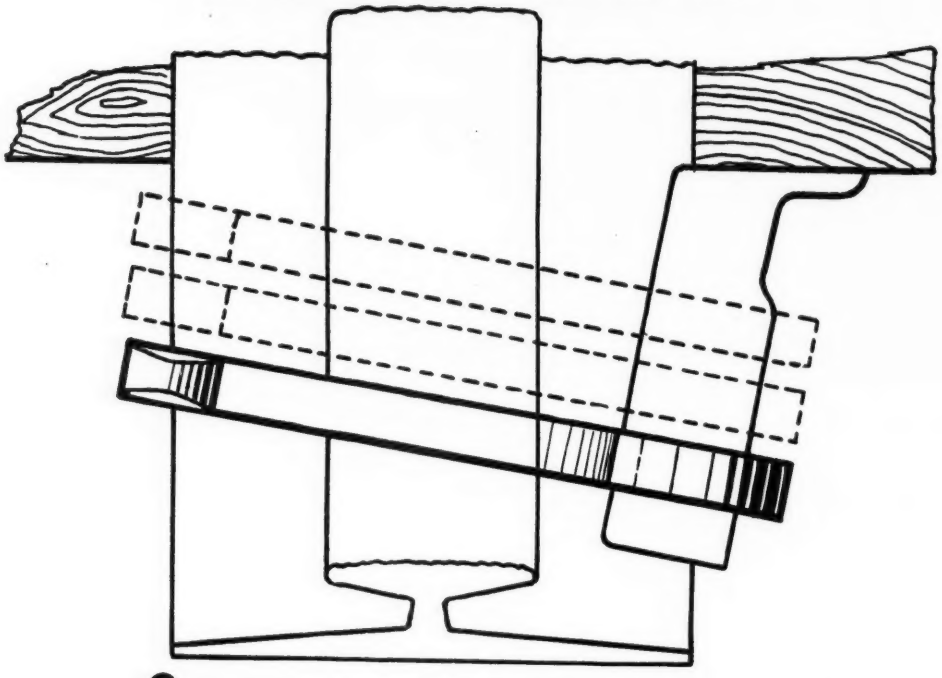
The most effective remedy is the installation of rock drains. A trench, 4 to 8 feet wide, carried on a grade of 4 to 6 per cent is dug at right angles to the track from the toe of the fill through and below the lowest point of the pocket. Toncan Iron Perforated Culvert is laid at the bottom of the trench on a bed of coarse stone, and the trench backfilled with "one-man" riprap—large stone at the bottom and graded upward.

Good engineering practice deserves the best in culverts—culverts that are structurally sound, and long-lasting. That's why your culvert specification should read Toncan Iron—the alloy of refined iron, copper and molybdenum with a resistance to rust that ranks first among the ferrous metals after the stainless irons and steels.

Suggestions to combat specific drainage difficulties will be sent upon receipt of full information and sketches outlining conditions.

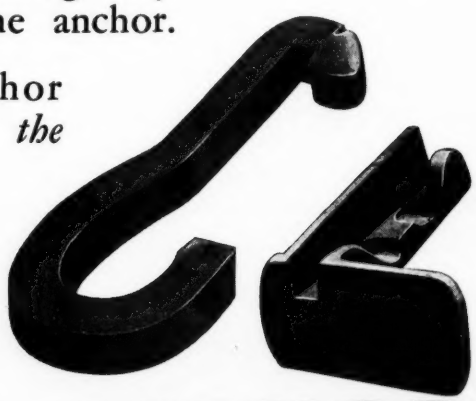


ADJUSTABILITY GIVES LONG LIFE



The ERICSON Rail Anchor is adjustable to many new positions on the tapered member of the malleable shoe or about 2″. This means that the anchor can be tightened on a new surface on each re-application, the amount of tightening surface never being fully used during the life of the anchor.

An ERICSON Rail Anchor may be re-used *without the slightest loss of efficiency* until the steel deteriorates beyond safety. Here is the ultimate in low cost maintenance of way.



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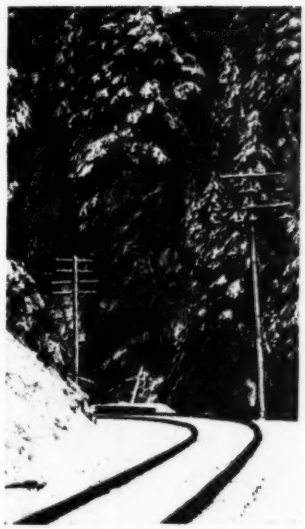

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

JANUARY, 1933

Editorial - - - - - - - - - - - - - 11
A general review of railway affairs in 1932, with particular reference to roadway and track and the trend of maintenance operations

Research on the Pennsylvania - - - - - - - - 14
Extended investigations in the laboratory and the field are developing valuable data on the behavior of track and the materials used in it

Fewer Crossties Inserted in 1931 - - - - - - - 18
Total placed in year amounted to 51,486,627 units, which represented a decrease of 19 per cent as compared with 1930

How Classify Relayer Rails? - - - - - - - - - 19
C. W. Baldridge discusses the proper handling for future use of material that has been released from main tracks

Keeping Tab on the Water Supply - - - - - - - 20
Centralized administration of the facilities for delivery and treatment is responsible for marked economies on the C. & O.

What a Diver Does on a Railway - - - - - - - - 23
Under-water man in regular service of the Boston & Maine spends about nine months a year in subaqueous inspection work

Problems of Wood Preservation - - - - - - - 25
Dr. Herman von Schrenk maintains that success depends on proper handling of wood from seasoning to design of structure in which used

Maintaining Electrified Lines - - - - - - - - 27
Chief engineer discusses the problems imposed by 3,000-mile overhead contact system on the track department

Special Hook for Throwing Out Rail - - - - - - - 28
Device used on Lehigh Valley designed to simplify this procedure during rail-laying operations by making it continuous

Installing a Multi Plate Arch - - - - - - - - - 29
Toledo, Peoria & Western employs interesting methods in replacing trestle with new type of corrugated structure

What's the Answer? - - - - - - - - - - - 30

News of the Month - - - - - - - - - - - 37

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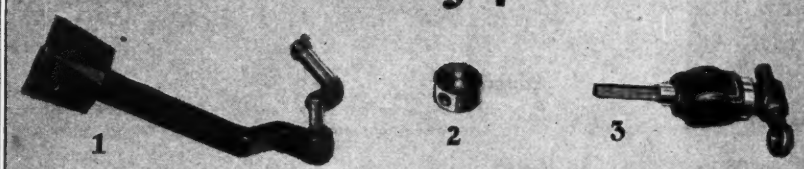
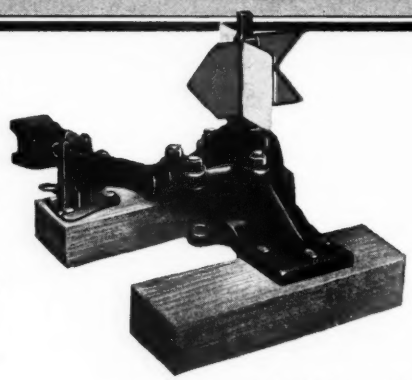
IT'S SO SIMPLE

3 working parts



and 2 structural members

make up the RACOR XL·36 SWITCH STAND



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There are only three operating members in the Racor XL-36 Switch Stand. These, made of rolled or forged treated steel, with extra large wearing surfaces, combine to form an exceptionally simple, gearless, parallel throw stand, ruggedly designed for heavy service in yards, terminals and on main lines.

The working parts consist of **(1)** the handle and shaft; **(2)** the roller in which the bearing of the shaft is inserted; **(3)** the spindle fitted with a slot in which the roller slides. The base **(4)** and the cover **(5)** complete the Racor XL-36—the switch stand of simplicity. It is a stand that has stood the test of time and abuse in many thousands of installations on the country's foremost railroads. Write for our free folder describing its use and installation.

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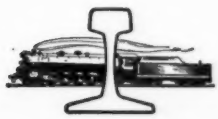
Railway Engineering and Maintenance



1932

A Year That Will Long Be Remembered

WHEN we commented a year ago to the effect that 1931 would go down in history as the period of most acute depression in this generation, we shared the almost universal belief that 1932 would witness a definite upturn. Yet as we now look back over the year that has just closed, it is evident that these expectations were not fulfilled, for business declined to new low levels on the railways as elsewhere and new measures of retrenchment were necessary to maintain solvency. The record has been one of adversity and yet, withal, one of achievement when one considers the odds that have been faced.

The effects of the widespread decline in industrial activities have been particularly acute on the railways for they, as the carriers of raw materials in and of finished materials out from the factory and farm, lose traffic as these industries curtail or suspend operations. Yet, drastic as the decline in volume of business has been, it has been far less than that suffered by many industries which have been forced to suspend operations entirely. To this extent at least, railway employees and those who sell materials and supplies to the railways have much to be thankful for, because even with their reduced operations, the railways spent more than $1,500,000,000 for labor and nearly $450,000,000 for materials and supplies during 1932.

The Year's Record

A summary of the year's record (based on returns for the first 10 months) shows the following facts:

Freight traffic declined to the lowest level since 1909, being about 25 per cent less than in 1931 and nearly 50 per cent below 1929.

Passenger traffic declined to the lowest level since 1901, being approximately 20 per cent below that of the preceding year.

Gross earnings declined to the lowest level since 1915, being about 25 per cent below those for 1931.

Net operating railway income declined more than 40 per cent from 1931 and more than 75 per cent from the figure for 1929.

The rate of return on property investment for the first 10 months of the year was 1.16 per cent as compared with 2.6 per cent for the same period in 1931 and with 4.84 per cent for the year 1929.

In the face of such a marked and long continued decline in traffic and in earnings, it is evident that railway managements had no alternative but to curtail all expenses to the minimum. As a result, activities of the maintenance of way department have suffered during the year, in common with those of other departments.

By reason of this fact, the expenditures for the upkeep of the roadway and structures were less for 1932 than for any year since 1909, or the lowest since labor and materials rose to their present levels. More specifically, the expenditures for maintenance of way and structures for the first 10 months of 1932 totaled $307,322,652, as compared with $470,254,468, with $620,090,685 and with $737,344,717 for the corresponding periods of 1931, 1930 and 1929, respectively. Based on these figures, it is estimated that the expenditures for the upkeep of the fixed properties for the year approximated $355,000,000 or $181,000,000 less than in 1931 and $507,000,000 less than in 1929.

Maintenance Expenditures

The annual expenditures of the Class I railroads of the United States for maintenance of way and structures for recent years follow:

1917	$ 445,735,253
1918	656,600,508
1919	778,340,219
1920	1,051,279,530
1921	764,662,651
1922	735,700,633
1923	821,376,694
1924	802,322,886
1925	824,892,860
1926	874,244,048
1927	878,289,313
1928	845,612,453
1929	862,701,113
1930	713,012,582
1931	536,305,045
1932 (last 2 months estimated)	355,000,000

These figures show most strikingly the toll that has been exacted of the fixed properties. If the expenditures for the years 1926-1929 be taken as criteria of the amounts necessary to maintain the properties in condition for the faster and more exacting traffic, the roads have fallen short of these expenditures during the last three years to the amount of $1,000,000,000 and this deficiency is being increased $1,500,000 every day.

That expenditures can be cut to such an extent is striking proof of the wisdom of making liberal appropriations for maintenance when earnings permit. To date the railways have withstood this drastic retrenchment with little real trouble, for the tracks still ride surprisingly well and there have been few evidences of weakening sufficient to cause trouble. That such a record could be maintained for so long a time is due only to the surplus strength plowed into the properties in the years preceding 1930.

It was in these years that the physical properties of the roads as a whole were brought to the highest condition in their history. Heavy rail, treated ties, stronger fastenings, more and better ballast and those other mate-

rials that enter into stronger tracks and better maintained properties were installed more generally than ever before. Likewise, expenditures were made with equal liberality for painting and for those other purposes which contribute less directly to safety of train movement, but which are just as necessary to a well organized railway. In these years, the roads made large purchases also of work equipment designed to bring their costs of performing the work to the minimum.

Compensating Factors

In considering the question of roadway maintenance, it must be recognized also that expenditures are, to a degree, affected by the volume of traffic. In other words, such expenditures as are necessary to make good the wear and tear of traffic, as, for illustration, rail replacement, are affected by the decline in business. With a decline of about 25 per cent in traffic handled during the year and of 50 per cent from the level of 1926-1929, the wear and tear on roadway and structures has been reduced appreciably.

Furthermore, the year which has just closed, like its predecessor, was characterized by a negligible labor turnover and by the maximum efficiency among workmen, with the result that the amount of productive work secured per dollar of expenditure was increased. To no small degree this result was made possible also by the recognition by maintenance supervisory forces, especially of the ranks of roadmaster and foreman, that the very acuteness of the difficulties confronting their roads demanded the best from every employee. As a result, the amount of productive work secured from each employee was considerably greater than that indicated by a comparison of the expenditures of recent months with those of five or six years ago.

Also the year was devoid of serious floods, severe winter storms and other adverse conditions that arise from time to time and that increase expenditures for roadway maintenance abnormally. To the exent also that roadway maintenance expenditures are influenced by rainfall, the year 1932 was, like its predecessor, favored in that over large areas of the country the precipitation was below normal.

Reserve Strength Being Drawn On

Important as these offsetting influences are, however, they fall far short of meeting the very heavy declines in expenditures referred to above. It would be folly to contend that the properties are in as good condition as they were four years ago, or even a year ago. Rather, it is self-evident that the reserve strength that was plowed into the properties a few years ago is now being drawn down. When it will be exhausted cannot now be determined. That it has carried the traffic so long is surprising to many. Especially is this true of those basic units of track construction, the rail and the crosstie. In the years prior to 1929, the railways normally purchased and installed somewhat in excess of 2,000,000 tons of rails annually. In 1932, the tonnage purchased has fallen considerably short of 500,000 tons, while that installed has been only a little larger.

Likewise, the railways normally renew some 75,000,000 to 85,000,000 crossties annually. In 1931, the renewals declined to 51,486,627, and such figures as are available indicate that in 1932 the renewals did not exceed 40,000,000. While it is recognized that with the growing use of treated ties, the renewals should decline somewhat, it is equally evident that the renewals during the last year have fallen far short of normal requirements.

To the extent that rail and tie renewals are typical of other materials subject to wear and tear, it is evident that replacement has fallen far short of making good the deterioration that has occurred. In many other activities not so directly affected by traffic, the deterioration has been far greater as, for instance, in painting where work has been all but stopped. The necessities of the situation have been such that every railway officer, general manager, chief engineer, division engineer, supervisor and foreman alike, has been forced to concentrate on those tasks that are most urgent and most directly related to safety of travel, to the neglect of those other worth-while but less urgent activities.

Improvement at a Standstill

As is to be expected, expenditures for improvements to existing properties reflected the same trend as those for the upkeep of those properties. With more than 600,000 surplus cars in good repair awaiting use, and with other facilities in proportion, there has been little incentive to increase the capacity or otherwise improve the facilities that are now being used far below their capacity. The year has therefore brought to a practical conclusion the greatest program for the improvement of railway properties ever launched—a program inaugurated in 1923 and in which the roads have expended more than $7,500,000,000 for the improvement and enlargement of their facilities, over and above those equally liberal amounts spent for their upkeep. This program, which involved the expenditure of approximately $850,000,000 a year, starting with 1923, was continued through 1930 at the urgent request of President Hoover, even after railway executives saw that the collapse of 1929 would be far reaching.

Since that year, the totals have shrunk measurably as one project after another has been completed and no new ones have been launched in their place, until today improvement work is practically at a standstill. This does not indicate that the possibilities for further improvements and economies in operation have been reached, for such is not the case. In fact, many of the measures that have been introduced in the last few years are so outstanding in the economies that they are producing that they will receive widespread adoption whenever traffic approaches normal volume. In the meantime, it is to be expected that capital expenditures will remain at a low level and that attention will be focused primarily on the upkeep of existing properties.

Little New Line Mileage

One index of the decreasing activity in capital expenditures is the mileage of new lines placed in operation during the year. This mileage totaled 163 for the United States, as compared with 748 in 1931, 513 in 1930 and an average of 671 miles for the 10 years preceding 1932. This is the smallest mileage completed in any year since the Civil war. The largest mileage built in any one state was in Texas where 114 miles were placed in operation. The longest single line built, 110 miles, was in the same state—the extension of the Fort Worth & Denver City from Childress to Pampa. In Canada the same condition prevailed, only 121 miles being completed last year, as compared with 250 miles in 1931 and 385 miles in 1930.

Equally significant of the times is the mileage of lines abandoned during the year. This mileage totaled 1,452, the largest for any year since these records have been compiled, with the single exception of 1921. It is interesting to note that the mileage of lines taken up during the year was nearly nine times that constructed.

Coincident with the widespread reduction in activity, employment has been at a low ebb. As recently as 1926, the railways employed 1,805,780 persons. Yet, in the past summer, the total fell below 1,000,000 and is less than at any time since 1900. In the maintenance of way department, this decrease has been pronounced, from the very nature of the work. It has been affected in part by the reductions in forces, as shown by the fact that the highest average monthly force during 1932 was 236,757 in May, whereas, the corresponding figure in 1930 was 408,042 in the same month of that year. Even more significant is a comparison of this maximum figure with the minimum monthly force in 1930—when 274,479 men were employes in December of that year. In other words, measured by the number of men employed, maintenance of way operations have been on a winter basis throughout 1932 as they were throughout 1931. It is encouraging to note, however, that the trend of employment is now upward, having increased from a low level of 996,317 employees in all departments in August to 1,010,400 in September and to 1,033,225 in October, an increase of 36,908 employees in the two months.

The decrease in forces would have been still greater if it had not been for the placing of many maintenance employees on a part-time basis to distribute the work that was available among as many men as possible. Through this means, many maintenance of way employees have been working two, three or four days per week.

Basic wage rates have undergone only one change during the year, a 10 per cent reduction negotiated between representatives of the managements and of their organized employes and applied to all employees. This reduction, which took effect on February 1, has just been extended until October 1, 1933, by further agreement between representatives of the railways and their employees. On many roads, reductions totaling up to 25 per cent have been made effective for maintenance and other officers.

One outstanding development among railway employees during the year has been their awakening to a realization that their interests are inseparably bound up with those of their roads and that any influence that affects their roads adversely affects them likewise. Out of this recognition have sprung organizations of railway employees in many areas, which are rapidly beginning to exert an influence locally, state-wide and nationally, for the correction of those conditions which are throttling the railroads and reducing the income of their employees. Especially effective, already, is the influence of these employee groups in focussing public attention on the unfairness of bus and truck competition and on the necessity for its regulation and control in the interest of public welfare. As this movement becomes more universal, its influence in behalf of the railways and their employees will become more pronounced.

Work Equipment

From the standpoint of work equipment, the year has not been without progress. The necessity for economy has been such that the equipment on hand has been employed to the maximum. In not a few cases, also, new equipment has been added, either to meet new conditions or to supplement that already in service. Thus, one road, as a step in the consolidation and enlargement of its section gangs, replaced all of its tie tampers with new models adapted to the larger gangs. Another road equipped all of its rail relaying gangs with the latest equipment for these varied operations. Still other roads have purchased equipment heretofore new to them to secure the economy therefrom. While the year has not been all that might have been desired from the standpoint of the equipment builders, it has not been without its bright spots.

Another development of the past year has been the marked trend towards the reorganization of gangs. In section gangs, this has led to the consolidation of forces to reduce the ratio of supervision and especially to increase the number of men in a gang in order to utilize work equipment more effectively and to handle the heavier materials of today. In special gangs organized for the performance of such tasks as the relaying of rail, ballasting, etc., the same objective—the more efficient use of work equipment—has led to the enlargement and more complete equipment of these gangs, looking to greater output and lower unit costs. Such gangs have effected marked economies on the Milwaukee, the Pennsylvania, the Boston & Maine, the North Western, the Erie and other roads where they have been employed.

What of the New Year?

The year which has just closed has been a tragic one for railways and employees alike. It has been one of disappointment. Yet it is not without its brighter side.

In the first place, the depression through which we are passing cannot last forever. Like the storm, every depression has an end, followed by days brighter than any previously enjoyed. Furthermore, as in passing through a forest, one can go in only half way before he begins to come out. So it is with us. We are at least on the way out, probably closer to the sunlight than we now realize.

Furthermore, we should not lose sight of the fact that, unlike many expenditures that are being postponed today, much of the reduction in maintenance expenditures represents work that is merely postponed and that must be done sooner or later, and that this deferred work constitutes a reservoir of employment and of orders that must be opened eventually. Furthermore, it is common knowledge that the limit of such retrenchment cannot be far distant. That the railways will utilize the first opportunity to make the necessary expenditures was evidenced last fall when outlays for both labor and materials increased with the first pickup in traffic.

From the standpoint of the builders of work equipment, this period is more than ever demonstrating the economy of such equipment and fixing it more firmly in the minds of maintenance men as an essential aid. Work equipment is demonstrating its economy more firmly today than in the days when such economy was less essential. The same attitude prevails with reference to those materials whose added strength has made possible continued operation with so little upkeep. When the tide turns, such expenditures will be more adequately appreciated than ever before.

As to the immediate future, it is impossible to forecast. There is one trend in recent weeks, however, which is not without significance to railway men. This is the tendency which has been displayed throughout the fall by carloadings. Not only did they increase more than seasonably throughout September and October, but they have declined less rapidly than normal since that time. Since carloadings constitute a cross section of business at large, they commonly reflect a trend more quickly than is apparent in other business indices.

When to this trend is added the growing appreciation of the public at large and of their representatives in state and national legislatures that the inroads of unregulated highway and waterway competition must be curbed, as evidenced by the rapidly increasing limitations that are being placed especially on highway transportation, it would appear that the railways are facing better days.

Finding Out What's What on the R

Maintenance of way materials are subjected to careful test and investigation by competent men with adequate facilities

The Contour Machine Answers Accurately the Questions of Rail Wear or Distortion

FEW railway employees, and very few of the general public, appreciate the extent to which the railways of the country conduct research, investigations and tests in the interest of greater safety, increased efficiency and reduced costs. There are a number of very natural reasons for this lack of knowledge, but the fact remains that the railways, individually and collectively, have carried on this class of work with increasing interest and energy, entirely auxiliary to their main function of providing transportation, until in recent years they have been spending, directly and indirectly, millions of dollars annually in such investigations.

A Large Laboratory at Altoona

No better example can be offered of the research and test work that is being done by individual roads than the Pennsylvania. This road, with a large laboratory and auxiliary testing plants at Altoona, Pa., undertakes thousands of tests and examinations each year and is working constantly to improve the materials and products used in the rail transportation industry. Much of this work is in connection with the materials, equipment and devices used by the mechanical and operating departments and is designed to insure the highest efficiency and safety in the work and output of these departments, but to an increasing extent and degree of precision, attention is being given also to the study, analysis and testing of methods, materials and machines used in the construction and maintenance of the roadway and track. Evidence in this latter regard is seen in the fact that all research, development and test work of primary interest to the engineering and maintenance of way departments is now concentrated under the direct supervision of a specially qualified engineering officer, located at Altoona, who, at the present time, is carrying forward some 225 separate investigations: This latter arrangement will be given major attention in this article.

Prior to 1928, all laboratory testing for the maintenance of way department was done by the mechanical department laboratory at Altoona, while the field testing was spread quite generally over the railroad. Authority for field tests was passed down the line from the chief engineer to the division engineers, who made test installations where they thought best, and then, of necessity, left them largely to the track or other field forces to accord them fair treatment and to keep appropriate service records.

This method had its obvious disadvantages. In the first place, the testing work was auxiliary to the routine work of the division forces, and, as such, was frequently given only secondary consideration. Not infrequently the locations selected for test installations were not the best possible, and, in some cases, the actual installations themselves were neither made correctly to produce authentic results, nor followed up closely enough to be conducive of accurate data. Transfers and promotions among division engineers and supervisors, and the shifting about of foremen complicated this situation still further, with the result that non-representative and incomplete data were secured from many of the installations.

Even where the greatest sincerity of purpose surrounded the tests, the true value of the results was often missed as a result of the widely varied interpretations placed upon the facts disclosed. The laboratory tests made by the mechanical department laboratory at Altoona were far more successful, but even these were often without their greatest possible value, lacking the experience of a practical maintenance of way officer.

Test and Research Work Reorganized in 1928

In the latter part of 1928, this entire arrangement was changed. At this time all testing of maintenance of way materials and equipment was put under the direction of the assistant engineer of standards, who, on the authority of the chief engineer, was charged with initiating and consumating all research and test work of primary interest to the maintenance of way department. Headquarters were established within the mechanical department laboratory at Altoona, which not only made possible the closest co-operation with the engineer of tests and the chief chemist of the road and their respective

Pennsylvania

Installing Apparatus to Determine the Stresses in Rails of Different Sections Under Different Loads at Various Speeds

departments, but which also located the center of maintenance of way testing within easy reach of ideal track and traffic conditions for making practically all classes of field tests.

The assistant engineer of standards has initiated several hundred projects covering a wide range of materials, tools and equipment. Some of this work covers the design, manufacture and treatment of rails; rail wear and deflection; the testing of many types of rail-joint construction in combination with different sections of rails and tie spacings; the study of the retardation of rail batter; and the testing in the laboratory and field of many devices such as rail anchors, bolts, nuts, nut-locking devices, spikes, tie plates, switch points, frogs, wheel stops, bumping posts, paints and anti-corrosive materials.

Among the track and roadway materials and appliances under test are several different types of highway crossing paving materials; also several types of lamps and signs for different purposes; more than a dozen types of rail and flange lubricators as well as oils and greases intended for curve oiling; and a number of types of snow melters and switch heaters. In addition, more than 40 tests are under way of a wide variety of track tools, including tamping tools, rail cutters, rail benders, rail drills, track jacks, weed cutters and track wrenches, and many service tests are being made of roadway machines.

Research enters to some extent into practically all of the investigations being made, and in many cases the investigations undertaken are entirely a matter of research. Among the latter are the study being made of internal stresses in rails, joint bars and track bolts; the investigation of the causes of transverse fissures and the factors which enter into rail batter; the development of a scientific method of heat-treating rail ends, and the study of the most practical method of fastening tie plates to the ties to avoid mechanical deterioration of the ties.

Some of the examinations called for, especially those confined to the laboratory, can be consumated in a relatively short period of time. On the other hand, most of the field tests or investigations are designed to let actual service conditions disclose the merits or defects of the items under consideration, and therefore, require extended periods of time.

Tests or research to be made on maintenance of way subjects usually originate with the chief engineer, or the assistant chief engineer in charge of maintenance, or the assistant engineer of standards, although suggestions may be made by others. However, no investigations or tests are undertaken without written approval of the chief engineer. With this approval, which usually contains suggestions of one character or another, the assistant engineer of standards draws up a prospectus of the proposed investigation under the following main heads: Subject; authority for test of .....; extent of test; purpose of test; method of test; comparisons; and remarks. When this outline of procedure has been approved by the chief engineer, the assistant engineer of standards proceeds to assemble the necessary materials and to arrange for the co-operation necessary on the part of the different departments or forces. Writing for the signature of the chief engineer, purchase orders are sent to the purchasing department for the materials or devices required in the tests, with definite instructions for the stores' department for shipping. Similarly, where extensive work is required on the part of the testing laboratory or the track forces, requests and instructions are sent to those concerned.

Thoroughly Equipped Laboratories Maintained

In the physical, chemical and electrical laboratories of the Pennsylvania at Altoona, the maintenance of way department has at its service some of the largest and finest research and testing facilities in the country. These laboratories, all housed in one three-story brick building, are operated under the general direction of the chief of motive power, and under the direct supervision of the engineer of tests and the chief chemist. In the layout of the building, the first floor is occupied by the physical laboratory; the second floor is occupied by the electrical laboratory and a part of the chemical laboratory; and the third floor is used exclusively as a chemical laboratory. The basement is utilized as a machine shop in connection with the work of the physical laboratory and, in addition, provides space for a gage room, storerooms and a shipping area. A pent house on top of the building houses a complete photographic laboratory.

Practically every form of physical, metallurgical, chemical or electrical analysis or test of interest to the railway can be made in these various laboratories. Some of the special machines and units of equipment provided include six tension and compression machines with capacities ranging from 300,000 lbs. to 1,000,000 lbs., an abrasion testing machine, a vibratory machine, machines for applying quick-bend and fatigue tests, a special rail-anchor testing machine, cement testing facilities, Brinnell and Rockwell hardness testing machines, power saws for cutting test specimens, and power grinders, polishing machines and etching facilities for preparing these specimens for study through the use of photomicrographs. These facilities are in addition to those in the electrical laboratory where all testing of electrical equipment and materials is done, and in the chemical laboratory, where analyses are made of all such substances as water, paints, waterproofing materials, lubricants and rubber.

Some of the major items of testing done by the physical laboratory for the maintenance of way department

include the examination of rail defects and failures; the drop testing of rails, which is done in a special drop testing machine equipped with a series of weights ranging from 1,000 to 27,000 lb.; the determination of the strength of welds and welded joints; and study of the strength and efficiency of rail joints under static loads, particularly in regard to deflection and lateral stiffness.

Field Tests Employed Whenever Practical

While many laboratory tests are invaluable and frequently are the only kind that is practical, greater faith is usually placed in field tests conducted under actual service conditions, it having been found in some cases that the results of laboratory and field tests are not in full agreement. For this reason, field tests are established whenever practical. Most of these test installations are made between Lewistown, Pa., about 70 miles east of Altoona, and Johnstown, Pa., about 37 miles west

The Investigations Are Aided by A Well-Equipped Testing Laboratory at Altoona

of Altoona. This territory, within easy reach of the testing force by either train or auto, provides heavy traffic conditions, and, including the crossing of the Allegheny mountains, affords practically every normal condition of grade and alinement. Because of the lack of some particularly desirable situation or condition, certain tests must be conducted outside the limits mentioned. The most notable of these have to do with railroad crossings, which are usually set up within terminals or at other points where the desired service conditions prevail.

Some of the most interesting field tests being made have to do with rail and rail joints. In these, which have required the manufacture of a considerable number of specially designed precision measuring instruments, many thousands of measurements are being made and recorded yearly to permit the accurate determination of results. Some of the specific rail tests cover treated and untreated rails of the Pennsylvania's new 131-lb. rail section. Others cover untreated rails of the Pennsylvania's new 152-lb. section and standard 130-lb. section. In all of these tests, where comparative results are sought, comparable traffic, alinement and grade conditions are provided in the installations and the greatest of care is exercised to see that balanced conditions are not disturbed during the test.

Rail Abrasion, Deflection and Batter Studied

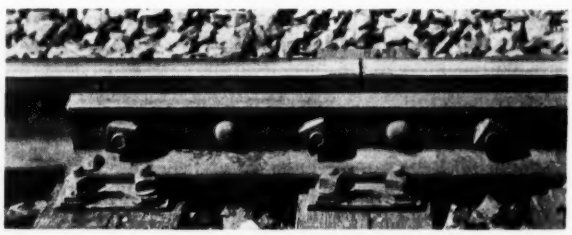
In the rail tests, which usually embrace certain features of the joint construction, the measurements taken include abrasion, joint deflection, rail batter, joint opening, and wear in the rail fishing area. All of these measurements are recorded immediately after an installation is made and then subsequently at such intervals as may be considered necessary or advisable to disclose the facts being established.

Rail abrasion is measured with a contour machine which is readily clamped over the rail head. This machine records on a card in pencil the exact contour of the head as traced by the feeler points of the machine in the hands of the operator. By superimposing the outlines of these actual worn head sections on sheets bearing true sections of the rail, any abrasion or change in the head is readily observed and the amount of abrasion can be determined accurately by the use of a planimeter. To give the records their fullest value, the degree of track curvature is measured at each point of contour reading. This is effected with a specially designed instrument fitted with a 20-ft. length of wire and a precision scale for middle ordinate measurements.

In measuring rail and batter, readings are taken with a 10-in. steel straight-edge set on top of the rail head with three inches of its length extending over the delivering rail and seven inches over the receiving rail. The straight-edge is provided with a sliding rider on its top edge, which carries an Ames dial gage, the depth member of which extends to the top surface of the rail. This gage indicates the distance between the rail and the bottom of the straight-edge, or the amount of batter, within 0.001 in.

Joint deflection is measured with a 48-in., graduated straight-edge set on top of the rail, each end of which is supported on a metal block 0.1 in. high, attached to the straight edge. Distances between the bottom of the straight-edge and the tops of the rails are measured in thousandths of an inch at the rail ends and at distances of 3, 6, 12 and 18 in. from the rail ends, the measurements being made with taper gages. To simplify the statement of conditions found at joints, and to make possible ready and accurate comparisons between joint conditions in different tracks, the measurements taken at joints are reduced to a common basis, or index. This is done by taking into consideration both the difference in measurements at different times and the tonnage which has moved over the joints.

The space between rail ends, if any, is measured by a taper gage reading to 1-32 in., and the temperature is



This Rail Joint Indicates That the Heat Treatment of Rail Ends Retards the Flow of Metal in the Head.—Later, the Section of Track on Which This View Was Taken Will Show Also the Effect of Bolting Tie Plates to the Ties to Minimize Wear

noted at the time of measurement. To determine the amount of overflow on both rail ends, taper gage readings are taken on the outside face of the rail head just above the joint bar where there is no distortion or overflow, and also on top of the rail head at the gage corner, and the two readings are subtracted.

Many field measurements are made in connection with the numerous rail joint tests, these including, in addition to rail deflection, rail batter and rail end overflow measurements as mentioned above in connection with the rail tests, the measurement of vertical deflection under static engine loads, which is effected with special graduated scales and a surveyor's level; the measurement of the

amount of take-up in joints as wear occurs on the bars and fishing surfaces of the rail, which is effected with a specially designed U-shaped instrument with a micrometer gage reading to hundredths of an inch; and the measurement of the wear in fishing surfaces, which is made with feeler gages. Other measurements made in connection with the field tests of rail joints include the measurement of the lateral deformation in joint bars, made with special gages in connection with an Ames dial gage, and the measurement of the vertical and lateral camber in free bars, made with another style of straight-edge and taper gages. In all joint tests, a most careful record is kept of the tonnage moving over the tracks and of all man-hours of labor expended in joint maintenance.

Some of the most scientific tests which have been made on rails and rail joints on the Pennsylvania were those conducted in 1930 with magnetic strain gages and oscillographs. These tests were designed to determine the

Measuring the Stresses in Track Bolts

horizontal and vertical forces exerted by locomotives and cars of different weights and classes operating at different speeds up to 104 m.p.h., and also the resultant stresses set up in the rails, joint bars and joint bolts. These tests, which extended over a period of about six weeks, produced many interesting results, not only in connection with a study of the different parts of the track structure, but also with respect to features of locomotive design.

Rail Defects and Heat Treatment of Rail Ends

With transverse fissures and rail end batter presenting two of the most troublesome and costly problems of track maintenance, a considerable amount of attention has been given to these subjects. Ever since 1929, with the development of the transverse fissure detector car, the Pennsylvania has had one or more of these cars in operation, weeding out suspicious rails and accumulating data of value in studying the cause and growth of transverse fissures. Furthermore, hundreds of defects have been studied with the photomicrograph and the closest attention has been given to the mill practices under which the rails are rolled.

In attempting to counteract the tendency of normal rail ends to become battered under traffic, the Pennsylvania has lent aid in the study of heat treating the head at rail ends, which is designed to increase the hardness and toughness of the metal at these points. The particular contribution of the road has been in further developing the practicability of this practice, to the end that more uniform methods and results might be secured.

Tests of heat-treated ends on the Pennsylvania have thus far indicated that the desired increase in hardness and toughness is brought about by heat treatment, heat-treated ends, as compared with untreated ends in the same track, showing increased resistance to batter and flow. Furthermore, the metal in the heat-treated portions of the rail is showing much greater resistance to distortion and flow than the untreated metal in the remainder of the rail.

Tie Plate Fastenings under Test

Another important item of work that is being carried out through the maintenance of way test department is the study of the value of fastening tie plates rigidly to the ties to minimize the wear of the ties under the plates and to prevent spreading gage. In this study two types of tie plates and three methods of anchoring them to the ties have been put under test throughout approximately a mile of track. The different methods of fastening the plates include the use of two cut spikes as anchor spikes, four screw anchor spikes, and four ¾-in. bolts extending completely through the ties. In all cases, cut spikes were used to hold the rail. The plates used have either flat or wave bottoms. All ties installed in the test section were new, of red oak, and treated, and all of the plates attached with screw spikes or bolts were applied at the treating plant, the bolted plates being put on under an external pressure of approximately 30,000 lb. Furthermore, the different forms of anchorage were used equally on curved and tangent track.

Immediately following the installation of the test section, measurements were taken at both the inner and outer edges of the plates, between machined surfaces on the tops of the plates and the heads of brass nails driven into the ties, to establish the initial height of each plate above the top surface of the tie. Similar measurements over a period of years will show the full effect of anchoring the plates to the ties and the relative effectiveness of the different methods employed. Already, after little more than a year in service, indications point toward the value of fastening the plates

A Stretch of Track in the Territory in Which Most of the Field Tests Were Made

securely, and, furthermore, to the fact that there will be less mechanical deterioration of the ties under the plates where the bolt and screw spike anchors are used than where the fastening is made with cut spikes.

Special Committee Studies Machines

The study and testing of roadway machines on the Pennsylvania is practically all done in the field under the direction of a special engineering committee, called the Committee on Development of Maintenance of Way Machinery, which is made up of a representative of the chief engineer, a representative of each regional chief engineer maintenance of way, and the assistant engineer

of standards, who acts as chairman. This committee holds frequent meetings on the call of the chairman, arranges for and witnesses actual operating tests of all machines where such are considered necessary. As a further check on the quality of machines offered to the road, all new units are given consideration by the mechanical department under the chief of motive power, which views them primarily from a mechanical standpoint. Some of the machines which have been given consideration in the manner outlined above include ballast cleaning equipment, motor cars, cranes, mowing machines, tie tampers, rail layers, track raising and lining units, power adzers and power ballasters.

The testing of track tools, including different types of drills, claw bars, picks, rail benders, rail cutters, rail forks, rail pullers and expanders, rail tongs, spike setters and starters, tamping bars, track jacks, track liners, weed cutters, etc., is concentrated under the direction of the assistant engineer of standards at Altoona. Such laboratory testing as may be necessary to determine the character and strength of materials is carried out by the mechanical department testing laboratory on request, and field tests are carried out largely through the track forces in their routine work. In all cases, close check is made of the quality and effectiveness of the tools, and of their ability to stand up under the work for which they are designed.

In addition to the extensive research and test work which the Pennsylvania conducts on its own property, it also carries out many studies and investigations of methods, materials and equipment employed on other roads, and of the facilities and manufacturing methods of companies supplying materials, tools and equipment to the railroad. Thus, many investigations are made at steel mills and manufacturing plants with the hope of bringing about the closest co-operation and, as a result, direct benefit through better adapted or higher quality products.

Large Benefits Expected

One of the outstanding features of the investigating and test work being conducted by the maintenance of way test department of the Pennsylvania is the care with which this work is carried out, and the precision and detail with which all observations and measurements are made. This is a direct result of centralizing the responsibility in specially qualified hands, fully equipped with appropriate testing equipment and measuring instruments, even to the extent of providing many specially designed units unavailable in the market. Guesses and suppositions have been eliminated, as have also the conflict of results secured from widely separated tests under variously comparable conditions and in the hands of variously competent forces.

Although many of the tests, investigations and studies undertaken are incomplete at the present time, the Pennsylvania, on the basis of the results secured thus far, is convinced of the value of the research and test work as is now being carried out. Its studies of rail and of rail steel composition, and the new rail sections which it adopted as a result of these studies, insure increased safety and comfort in travel and promise large savings in expenditures for rail renewals, and its study of the heat-treatment of rail ends promises further to improve riding conditions, to reduce maintenance expenses and to increase further the service life of rail. The transverse fissure problem has not yet been solved, but the work of the Pennsylvania in this regard has added largely to the safety of its tracks and has contributed materially toward an ultimate solution of the problem.

Many refinements in the track structure, with greater efficiency of the individual units involved and the structure as a whole will result from the many tests under way, with both increased safety and economy of maintenance. Already, many track materials and tools have been subjected to the critical scrutiny of the maintenance of way testing department, some to be discarded as inefficient or inadequately developed to meet the requirements of the road, while others have been accepted and recommended for purchase and use in accordance with their particular merits. Similarly, the study and tests of roadway machines have resulted in the purchase of only those units best adapted to service requirements, and in this way have not only kept inferior equipment off from the road, but have resulted in the greatest economy in the use of machines.

Aside from these large advantages to itself, the test and research work on the Pennsylvania is having a far-reaching effect upon the railroad supply industry and upon the practices of other roads, all in the interest of safer and more economical rail transportation.

T. J. Skillman is chief engineer of the Pennsylvania, while F. M. Graham, assistant engineer of standards, and his assistant, E. E. Martin, assistant engineer, are in direct charge of the maintenance of way department test work. All laboratory testing for the maintenance of way department is done under the direction of F. M. Waring, engineer of tests, and M. E. McDonnell, chief chemist, mechanical department officers, acting under F. W. Hankins, chief of motive power.

Ties Inserted in 1931 Decrease 19 Per Cent From 1930

THE Class I railroads of the United States inserted 51,486,627 wood crossties in previously constructed tracks in 1931, as compared with 63,338,798 in the previous year, a decrease of 11,852,171, or 19 per cent, according to figures issued by the Bureau of Railway Economics, which are based on official summaries of the Interstate Commerce Commission. These figures, together with others showing the number of board feet of switch and bridge ties installed and the number of crossties inserted, classified according to untreated, treated and other than wood ties, are given in the accompanying table for 1920-1931, inclusive. They should not be confused with figures showing the number of ties purchased by the railways, which were published recently by the Bureau of the Census and summarized in *Railway Engineering and Maintenance* for November. In the latter tabulation it was shown that the railroads purchased 43,737,809 crossties in 1931, the difference between this figure and that for the number installed indicating that

Ties Laid in Previously Constructed Tracks*

	Untreated Ties No.	Treated Ties No.	Other Than Wood Ties No.	Total, All Cross Ties* No.	Switch and Bridge Ties Ft. b.m.
1920	48,631,543	37,792,431	154,378	86,829,307	246,195,929
1921	49,238,665	36,071,989	536,188	86,521,556	256,287,730
1922	45,212,085	40,629,943	554,250	86,641,834	258,186,478
1923	42,072,140	41,655,616	447,002	84,434,985	277,615,107
1924	38,317,244	44,489,687	3,360	83,073,059	291,288,388
1925	32,623,486	50,089,966	3,222	82,716,674	282,629,608
1926	25,184,662	55,557,706	3,141	80,745,509	275,971,880
1927	21,240,053	57,082,993	17,136	78,340,182	259,996,468
1928	18,191,677	59,157,540	21,724	77,370,941	269,149,270
1929	15,614,898	59,047,380	17,097	74,679,375	250,062,751
1930	13,618,718	49,720,080	15,030	63,353,828	235,314,604
1931	11,658,836	39,827,791	15,032	51,501,659	188,594,522

*From 1920-24, inclusive, these figures include second-hand unclassified wood ties in the following amounts: 1920, 250,955; 1921, 674,714; 1922, 245,556; 1923, 260,227; and 1924, 262,768.

a considerable proportion of the ties inserted was taken from stocks already on hand.

In the table it is shown that there were 188,594,522 ft. b.m. of switch and bridge ties placed in 1931, a reduction of 46,720,082 ft. b.m., or 20 per cent, below the corresponding figure for 1930. The number of ties other than wood, however, totaled 15,032, which showed no variation from the number inserted in 1930. This classification of ties, of which 554,250 were installed in the peak year of 1922, comprised only 0.03 per cent of the total placed in track last year.

Of the total number of crossties inserted, 39,827,791 were treated and 11,658,836 were untreated, the percentages of the total being 77 and 23, respectively. In 1920 the number of treated ties installed amounted to 43 per cent of the total and untreated ties 56 per cent, since which time there has been a constant increase in the proportion of treated ties.

How Should Relayer Rails be Classified?*

By C. W. BALDRIDGE

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SINCE released rail varies over a wide range as to quality, because of the amount of wear to which it has been subjected, the resistance it has offered to the forces which have been applied to it and the effect of other external conditions which have surrounded it, it is always necessary to classify it carefully to adapt it properly for further service. In discussing these classifications, however, it is scarcely necessary to consider the measurements of wear, which might act as a limitation on the various classes into which the rail is to be separated. There are two reasons why this is so.

In the first place, limits of wear that might be acceptable to one road might be entirely unsuited to the conditions on another. Again, rails that have been laid at or near the same time in the same track, and have thus carried the same traffic, should differ so little in the amount of wear that the only need for classification is to segregate those having local wear spots, driver burns, defects and heads subjected to the characteristic flowing of the metal in the low rail on curves, as well as a few individual rails. For these reasons, the taking of extensive measurements of wear or any discussion of the subject is a waste of time.

Released Rail May Be of Two Kinds

To clarify the terminology, released rail may be of two kinds. Rail released from main tracks that have been abandoned because of line changes or for other reasons ordinarily is suitable for the same service it has performed heretofore. On the other hand, the term as usually used applies to rail that has lived its service life in the track from which it is being removed, but is still suitable for less severe or less important service in other tracks. The latter case is the one that will be considered.

Rail that is released because the first cycle of its service life has been completed should be classified into four groups. These are: (1) Rails suitable for use in frieght main tracks or in important branch line main tracks; (2) rails which cannot be classed as No. 1 relayers, but which are suitable for use on unimportant branch lines, main-line passing sidings and yard leads; (3) rails not classifying as (1) and (2) but suitable for sidings and yard tracks; (4) scrap, including all rails not suitable for use in side tracks.

Rails meeting the requirements of the first classification must be sound, straight, free from local wear spots, driver burns and chipped ends, and not flattened or otherwise badly worn. Those in Class 2 should include sound rails which are within prescribed limits of curvature or bends, which do not have wear spots or burns of consequence and which are not flattened or worn beyond prescribed limits. Battered rails or those with chipped ends can generally be classified in accordance with the condition of the rail away from the ends by rebuilding the ends by welding, provided it is the policy of the road to make such repairs. If welding is to be done, it should be done immediately after the rail is relaid.

Class 3 relayers should include all rails of known transverse-fissure heats, those having wear spots, driver burns and other defects which make them unfit for main-track use, but which do not unfit them for use in side tracks.

Scrap rails, Class 4, should include all rails which are so badly worn or which contain defects which make them unfit for further use, even in side tracks. There should be very few scrap rails in rail released from important main tracks, for rails which are in condition to carry important main line traffic today should certainly be suitable for side-track use for a long time in the future.

In general, the classification and making of relayer rail should be done in the track before the rails are released, and this work should be carefully checked after they are removed. Some rails are quite likely to contain defects, bends, etc., which escape notice while they are in the track but which are readily apparent after they are removed, and a check will make it possible to reduce them to the appropriate classification.

A convenient system of marking consists of one vertical paint mark for No. 1 relayers, two stripes for No. 2, etc. Where this system is used, any rail requiring reclassification can be given one or more additional stripes as may be necessary. Relayer rails seldom look better after their removal from the track than they did while still in the track.

Rails that are removed from abandoned tracks constitute special cases which must be handled in accordance with the condition of the rail. In some cases, they may be no better than those that have been under discussion, in which event the classification should be made in the same manner. If they are in condition for reuse in the same class of track from which they came, no classification is likely to be necessary.

*This discussion was submitted for publication in the What's the Answer department, but because of its scope, it is presented here as an independent article. For a further discussion of this subject, see page 35.

A Well Kept Section Headquarters

It Pays to Keep
on the

Centralized administration of the construction and operation of the facilities for delivery and treatment is responsible for marked economies and more reliable supplies on the C. & O.

The Water Station and Treating Plant of the C. & O. at Vauces, Ohio

THE Chesapeake & Ohio, as a part of its program of improving existing facilities and providing additional facilities for handling a larger volume of business, created a water supply department in December, 1922, with a superintendent of water supply on the general office staff in order to centralize the control of the design, installation, operation, and maintenance of the water stations as well as the treatment and correction of the quality of the water. Steps were taken at once to insure that the best possible results were being obtained in the operation of the existing facilities. A system of supervision was set up to see that defects in equipment were discovered before emergency measures were necessary, and, in the case of water treatment, that man failures would not contribute to improper performance due to inadequacy of plants. In a word, the whole plan was founded on the idea of fixing responsibility all along the line so that someone would be directly accountable for any water supply failure that occurred.

Improvement of the facilities was carried out concurrently with the development of the water supply department and the projects completed between 1923 and 1929, inclusive, embraced 6½ million gallons of tank storage, mostly of steel construction; 12 complete new pumping stations in addition to 11 new oil engine-driven and 6 electric motor-driven pumping units installed in old plants; 26 water columns; 16 new pipe lines or extensions of old ones; and other facilities. The extent of the improvement in facilities is indicated by the fact that of 202 water stations now in operation, 150 are provided with efficient modern equipment, whereas in 1922 only 19 out of a total of 204 plants were of types that could be classed as other than obsolete or inadequate.

The program for improving water station facilities was planned with due consideration to a concurrent program for providing locomotives with tenders of greater capacity, since this necessarily called for water at a fewer number of stations and pointed to the possibility of abandoning certain stations while insuring water supply at intervals consistent with the needs of the locomotives equipped with the smaller tanks. These large tenders have proved particularly advantageous in reducing the number of train stops formerly made for taking water, and also in permitting the locomotives to run by stations of inadequate supply or bad quality.

Focus Attention on Water Treatment

Improvement in the quality of the water delivered to locomotives and stationary boilers occupied an important place in the program. Water treatment was undertaken as early as 1912 when nine small lime-soda ash plants were installed on the Chicago division, which, together with a few on other divisions, increased the total to 14 in 1922. However, some of these older plants were of inadequate size to meet the growing demands for water and much water of poor quality was not being treated. Furthermore, the treatment at the plants was not under adequate chemical control and, on the whole, the quality of water supplied to boilers was far from satisfactory.

Following a study of the treating facilities and their performance in 1923, several of the old plants were abandoned and a greater number of new ones were built. This work was continued from year to year so that in 1929 there were 72 water treating plants in service, with the result that at present approximately 80 per cent of the water delivered to locomotives is being subjected to some character of treatment.

Of the 72 plants, 45 are lime-soda ash plants (43 continuous and 2 intermittent), 14 are sodium-aluminate plants, 10 provide road side soda-ash treatment, 2 are zeolite plants, and one is a soda-ash sodium-aluminate plant. The quantities of water treated in these 72 plants in 1931 were as follows:

No.	Type	Gallons Treated
45	Lime-soda ash*	3,322,050,000
14	Sodium aluminate	461,216,000
10	Soda ash	76,324,000
2	Zeolite	69,877,000
1	Soda-ash sodium-aluminate	28,223,000
	Total—all plants	3,957,690,000

*Sodium aluminate is used with the lime soda-ash in 80 per cent of these plants to assist in coagulation and for speeding up the reaction.

The success of the program has been due, as much if not more, to the care with which the improvements were designed and constructed and to the efficiency with which they are operated and maintained. This must be accounted for by the plan under which the system water supply department has worked in close co-operation with the various units of the property.

The need for additions and betterments to water supplies originates in large part with the divisions, which must of necessity provide much of the operating data on which studies for new facilities are founded. The division supervisors of water service, together with the pumpers, water treating operators and repair forces are carried on the division engineer's payroll and are responsible to him for the work they do. To fit into this arrangement, the staff of the system superintendent of water supply is organized to fulfill three separate functions, namely, design, chemical control, and supervision of plant operation and maintenance.

The first function embraces the work of an assistant engineer of water service design who, with one or more engineer-draftsmen, works out the various hydraulic problems, studies the physical requirements of each project and develops the plans from which the construction

Tab Water Supply

is carried out. This force has also done much to standardize water service equipment on the C. & O., as outlined in following paragraphs.

The second function requires the services of a chief chemist and four assistant chemists who check and regulate the treatment of the water at all treating plants at least twice each week and oftener if necessary. Laboratories are maintained at the department headquarters at Huntington, W. Va., and at Peru, Ind., and Columbus, Ohio. Samples of water sent into these laboratories are tested regularly for hardness, alkalinity and causticity, and if any change in the treatment is found necessary, instructions go out the same day that the samples are received. In addition, water from each plant is checked for chlorides once each month, and complete quantitative analyses for dissolved solids are carried out whenever it is deemed necessary.

A measure of the result of this rigid supervision of the treatment is afforded by the fact that of 6822 samples of treated water received at the laboratories during 1931, only 54 or 0.8 per cent were found on test to show "treatment failures," whereas in 1923, when this system was introduced, 29.3 per cent of the samples disclosed such "failures." In accordance with an arbitrary rule adopted by the department a sample is rated a "treatment failure" when it tests more than three grains per gallon of hardness if it is taken at a lime-soda ash plant, or less than two grains of alkalinity in excess over the hardness if taken from a soda ash or sodium-aluminate plant. In addition to 14,145 analyses of treated water, the chemists in 1931 made 9,485 tests of raw water, 69 complete water analyses and 602 boiler water analyses, in addition to 281 miscellaneous analyses of chemicals, coagulants, salt, oils, etc.

As a consequence of this close check on the performance of the treating plants it has been possible to apprehend defects in treatment and institute corrective measures quickly. However, the high standard of operation obtained is due not so much to the correction of defective treatment when discovered, as to the effect of the close supervision on the attitude of the plant operators toward their work.

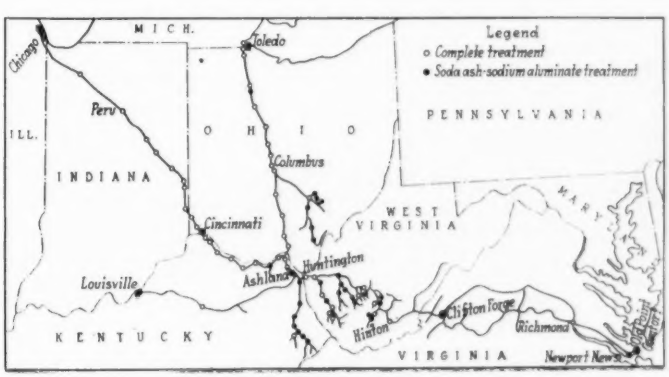
The beneficial results of water treatment are evidenced by the fact that it has been possible to increase the interval between boiler washouts from as short a time as three to four days to the full 30-day statutory limit.

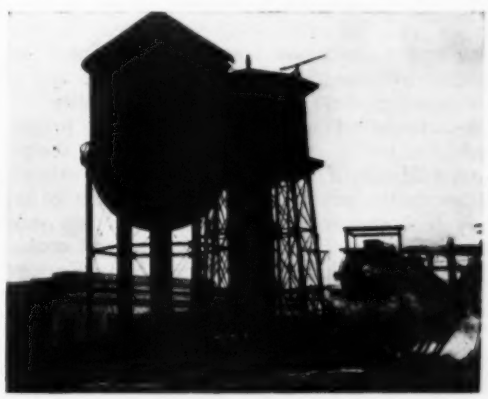
In addition to the direct operating saving thus realized, it has been possible to postpone indefinitely projects for increasing the number of stalls in roundhouses. However, increasing the time between washouts has given rise to the need for carefully prepared blow-off schedules for the various engine districts, based on analyses of water taken from locomotives on the road. During periods of extreme drought when the concentration of dissolved solids has increased very rapidly in certain districts, an even closer check has been maintained by stationing chemists at engine terminals so that they may make analyses of the boiler water of each locomotive before it is checked out.

Operation and Maintenance

The third function of the water service department is exercised by three inspectors, a chief and two assistants, who are continually on the road, not only checking the operation and maintenance of the water service facilities but also instructing the water supply forces in the details of their work. As a result, the pumpers and repair men know what is expected of them, the plants are kept clean and orderly and, above all, defects in methods and in the physical condition of facilities are discovered before they are sufficiently serious to result in breakdowns. The work of the repair forces is, therefore, conducted according to an orderly routine which is broken only at infrequent intervals to take care of the emergencies occasioned by unusual breakdowns or other conditions resulting in interrupted service at any of the stations.

Measurable economies have been effected as the result of steps taken to effect a gradual standardization of water service equipment, including steam-pump boilers and appliances, steam pumps, water columns, valves, hydrants, pipes and fittings, packing, tank fixtures, and chemicals. This has not been carried out in an arbitrary way that would result in the scrapping of valuable equipment and confine purchases to a limited group of manfacturers, but along thoroughly practical lines. For example, as the improvement program was carried out, steps were taken to concentrate particular sizes and makes of equipment on certain divisions. Also in the case of pipe, 5-in., 7-in., and 9-in. sizes have been elimi-





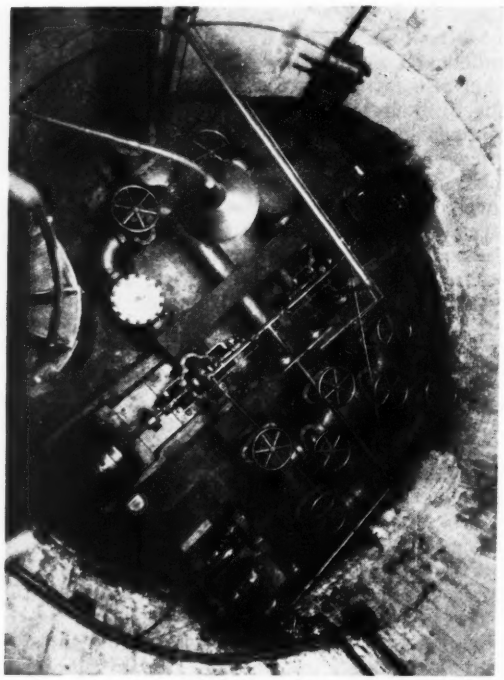
Left—Map of the C. & O., Showing the Distribution of the Treating Facilities. Above —A New 200,000-Gal. Steel Storage Tank at Huntington, W. Va.

nated, thus doing away with the need of carrying fittings for these sizes in stock.

Along with the reduction in stocks that has attended the movement for standardization, much progress has been made in the more systematic handling of requisitions for repair parts and other materials. Standardization has carried with it the more specific description of all materials used so that there is now no excuse for a misunderstanding as to what is wanted. As a further check, all requisitions are reviewed in the office of the water service department before they are sent to the stores department.

Costs Are Recorded

Among the most important factors in the attainment of economy in water service is a system of cost records whereby both the division staffs and the superintendent of water service receive monthly statements of operating and maintenance costs for each water station, together with the gallons of water pumped, and in the case of treating plants, also the amount of water treated and the amount of chemicals used. This information, in addition to the record of the treatment, compiled from the analyses of the water made in the three chemical laboratories, provides the superintendent of water supply with complete data on which to pass judgment on the efficiency of each water station and enables him to run down quickly any deficiency in performance.



Looking Down Into a Pump Pit Equipped With Modern Electrically-Driven Centrifugal Pumps

Something of the results obtained by the improvements in plants and organizations for water supply on the Chesapeake & Ohio is afforded by the following comparison of figures pertaining thereto for 1923 and 1931. Thus, although the track mileage increased from 2552.7 to 2732.6, or 7 per cent, and the traffic handled from 25,153,672,000 gross ton-miles in 1923 to 39,958,716,000 in 1931, or 59 per cent, the number of water stations was reduced from 207 in 1923 to 204 in 1931, while the water pumped or purchased decreased from 7,653,490,000 gal. in 1923 to 6,211,448,000 gal. in 1931, a reduction of 19 per cent, which is ascribed to better facilities and a campaign for a reduction in water waste.

The 72 treating plants in service in 1931 removed 5,357,100 lb. of encrusting solids from water supplied to locomotives and other steam generating equipment.

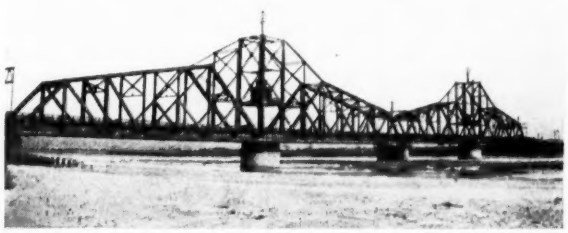
It is estimated that the removal of this material resulted in a gross saving in locomotive operation and maintenance of $696,500, which, after deducting $198,502 for the cost of treatment, leaves a net saving of about $498,000 as the return on a plant investment of $572,710.

The facilities for the treatment of water were also put to a severe test by the drought of 1929 and 1930, because of the marked concentration of dissolved solids that occurred in many supplies, especially streams, with the decrease in the discharge. This resulted in an increase in the outlay for chemicals but in only a minor falling off in the quality of water delivered to locomotives. It is apparent also that without the improved facilities and administration of water supply and treatment, the Chesapeake & Ohio would have been confronted with well-nigh insurmountable difficulties as a consequence of the drought during those two years.

In the absence of comprehensive statistics on water supply performance and costs prior to the formation of the department, there are no figures available covering the operations before 1923, which may be used in comparison with corresponding figures for later years. However, the records indicate that mechanical failures at pumping plants which previously had occasionally disrupted train service and compelled maintenance forces to devote a large part of their time to emergency repairs, have been practically eliminated. Heavy expenditures for boiler and fire-box maintenance previously caused by bad water have been materially reduced. On the divisions where flue renewals were formerly required at intervals of only 9 to 18 months, the life of these flues has been extended, in most cases, to the full four-year government limit, and in some cases special extensions over this limit are being granted. The constructive supervision given the water supplies has been an important contributing factor in the steady improvement shown by the statistics on locomotive performance as is indicated by the table of leaky failures of locomotives.

Locomotive Failures Due to Leaking Flues, Etc.

Year	Total Failures	Per Billion Gross Ton-Miles	Per Million Locomotive Miles
1923	186	7.40	7.57
1924	80	2.81	3.03
1925	15	0.45	0.523
1926	16	0.415	0.536
1927	5	0.131	0.172
1928	3	0.083	0.107
1929	4	0.084	0.129
1930	4	0.089	0.140
1931	2	0.050	0.083



Illinois Central's Duplicate Draw Spans Over the Missouri River

What a Diver Does on a Railway

Under-water man in regular service of Boston & Maine spends nine months a year in subaqueous inspection work

The Diver, Up From Below With Inspection Data and About Ready For Another Descent

WHILE practically every railway of any size has required the services of a diver at some time or other for special subaqueous work, and while certain roads, particularly those with tidewater properties, have need for such a man periodically for marine work of some character, it is so unusual for a road to maintain a diver in its regular employ that the practice of the Boston & Maine in this respect warrants description, with reference especially to the character of the work done by the diver, and the manner in which he is kept busy.

Indicative of the more important work which falls to his lot is the inspection of structures at Portsmouth and Newington, N. H., where the long timber pile trestles cross the Piscataqua river, and at the Boston terminal of the road, where, until recently, there was about as much trackage over water on pile trestlework as on land. With all three of these points subject to the attack of marine borers, the major part of the diver's work is under-water inspection, although there is a considerable variety of work at the terminal from time to time. Inland, the work of the diver has been confined largely to the examination of bridge abutments and piers and their footings at the larger river crossings.

The two crossings of the Piscataqua river are long single-track pile structures, located about four miles apart on different lines of the road. The structure at Portsmouth, located near the mouth of the river, is about 1,588 ft. long and carries an old roadway alongside the railroad deck. The piles in this trestle, which are arranged in bents of from 15 to 20 each, vary in length from 40 to 45 ft., spliced butt to butt with an elaborate bolted scarf joint to make single piles 80 to 90 ft. long. The other trestle crossing, which is located further upstream near Newington, is similar in design to the lower structure in that it has a toll roadway on one side of the track. It is somewhat longer than the Portsmouth trestle although the piles used are not as long. The piling in the Portsmouth trestle is untreated white oak, while that in the Newington trestle is untreated white oak and white pine with some treated long-leaf yellow pine driven lately.

The necessity for inspecting the subaqueous portions of the trestles is due primarily to the attacks of limnoria, which are particularly active in the waters at the mouth of the river, causing greater destruction to the piling of the Portsmouth trestle. Ordinarily the action of the limnoria is most destructve about two feet below low water, but at Portsmouth they attack the piling throughout its entire length. Piles are eaten through at the mud line long before the destruction at the splices reaches a dangerous condition. As a result of the attack of the borers, it is necessary to renew about five per cent of the piles each year . In the case of the Newington trestle, where there are relatively few spliced piles and where the attack of the borers is somewhat lighter, only about three per cent of the piles require replacement annually.

Careful Inspection Made

The program of the diver calls for a biennial inspection of all of the piles in both trestles, and the actual work in each case requires from 40 to 60 days. In making the inspection, the diver lowers himself along each pile and determines its condition by feeling it with his hands and by jabbing it with a sharp hook. Coming to the surface after an examination of each pile, he reports its condition to an attendant above the water, who records the data directly on a plan showing the location of each pile in each bent. With this record for each pile, the material necessary for a season's repair work can be ordered accurately in advance, and the repair work itself can proceed much more rapidly than if inspection is made concurrent with renewals. Where under-water cutting of the piles is resorted to, the diver is employed for this work.

The inspecting of the piles of the Portsmouth trestle is considerably more difficult than in the Newington trestle, owing to the greater depth of the water under the Portsmouth trestle, and, to a greater extent, to the strong tidal movement at this point. In fact, the flow of the tide at this point is so strong that the diver can operate with safety only in the slack water between

tides, and even then it is necessary for him to be on the alert for a change in tide, which takes place rapidly and with great uncertainty. On one occasion, while inspecting the piling in this structure, the diver was aware that the turn in the tide was about to occur, but continued with his work of inspection until the swift currents overtook him. He jabbed his hand hooks into the piling in an effort to secure himself, but his weighted feet were carried out from under him and he found himself in a horizontal position in the water. Next, he lost his hold on the piling and was swept downstream, gradually rising in the current until he was near the surface at the end of his signal and air lines, from which position his helpers were able to pull him to safety. Only the fact that he was operating from the downstream side of the structure, in the clear between bents, which insured against the fouling of his safety and air lines, prevented his being drawn into a most precarious situation.

Work is Varied at Boston Terminal

One of the large phases of the work of the diver at the Boston terminal is pile inspection, similar to that at the two trestle crossings of the Piscataqua river. An idea of the amount of work of this character at the terminal is seen in the fact that until the last few years approximately 3,000,000 sq. ft. of the terminal area was over water on pile structures. Even with the extensive filling work which has been done at the terminal during the last five or six years, there is still approximately 1,500,000 sq. ft. of trestlework, the piling of which requires inspection periodically.

The attack of limnoria within the terminal area is considerably lighter than in the Piscataqua river, which makes less frequent inspection of the piling necessary, but here, in many respects, the work is more difficult than in the river. This is because of the congestion of the piling in many parts of the old structures, the hazard presented by completely submerged piles and timbers of long-forgotten structures, and the turbid condition of the water, which, combined with the effect of the solid deck of the trestlework, makes it necessary for the diver to work in total darkness, even when only a few feet beneath the surface. The difficulty and hazard of working under water at many points at the terminal are illustrated by an incident which occurred last summer, when, while the diver was passing along the bottom in inspection work, his air and safety lines became looped around an old submerged leaning pile in such manner that it required careful maneuvering to extricate him safely.

In addition to the pile inspection work at the terminal, the diver handles the placing and inspection of all submerged cables, ducts, and water and air lines. Last summer, in connection with extensive improvements at the terminal, which involved a change in the location of the channel of the Charles river and the installation of entirely new signal and interlocking systems, the diver was employed to lay all of the cables under the bed of the new channel. In this work, where the cables were laid in a 2-ft. trench across the channel bottom, about 25 ft. below low water, to preclude their being damaged by passing steamers and barges, the trench was dug with an air gun. This piece of equipment was essentially a pipe nozzle, which was thrust down into the soft material of the river bottom where it could blow a clear trench. Following the completion of the trench, the diver supervised the laying of the cables to insure that they were placed properly. No attempt was made to back-fill the trench because it was known that the normal action of the river would take care of this rapidly.

Another item of work done by the diver during the course of the terminal improvement work was in connection with the sinking of certain of the caissons for a battery of four new double-track bascule bridges constructed over the new river channel. While putting down these caissons by the open dredging method, massive old timbers were encountered in several instances, which could not be moved or pulled out. The diver, with a saw, solved this problem easily.

There is little work for the diver, ordinarily, on inland structures in fresh water, but he has been employed in a considerable number of cases to inspect the piers and abutments of large bridges, and to examine their foundations for scour. A large amount of work of this character was done following the floods in New England in 1927, during which many bridges were damaged.

While a diver had been employed quite regularly on the Boston & Maine prior to 1911, it was not until that year that a regular diver was put on the payroll. Since then, this employee has gone about his work day after day, and so unobtrusively that, until recently, there were relatively few employees on the road who knew that there was a diver among them.

Small Amount of Equipment Required

The equipment necessary for his operations is relatively little, including two regulation diving suits, one a spare; three or four boats or scows, with ladders to assist the diver into and out of the water; and a two-cylinder, portable, hand-operated air pump for supplying the diver with air. The boats used are of the scow type, with a flat bottom and about 12 ft. long by 4 ft. wide, constructed of two-inch plank, although, in some cases, timber rafts have been employed. One of these scows, or a raft, with a ladder, is provided at each of the points where there is a large amount of inspection work to be done annually, making it unnecessary to move a scow from place to place. The rest of the diving outfit, including the air pump and hose, is moved about over the system with the diver, usually in the baggage car of a passenger train, although, where more convenient, as in reaching certain places around Boston, a light motor truck is used.

The crew employed with the diver includes a diver's tender and two pump men. The tender, who is regularly employed with the diver wherever he may be working, is, figuratively, his "aide de camp" in all of his operations. He helps him into and out of his diving suit, attaches his lead belt and sandals, places and adjusts his helmet, affixes his safety and air lines, assists him in rising and lowering in the water, and acknowledges and answers all of his signals. The work of the two pump men is primarily to man the pump and to insure that there is no interruption of the air supply to the diver. These men are usually bridge and building department employees who are picked up on the territory where the diving work is being done.

Under ordinary conditions the diver works under water from four to six hours a day, and is kept busy in diving work about nine months of the year. When not actually engaged in diving, he is employed as a bridge carpenter in the regular bridge forces of the road. The present diver on the Boston & Maine is Con Campbell, whose work is done under the direct supervision of F. C. Brackett, supervisor of bridges and buildings, and under the general direction of H. F. Fifield, engineer maintenance of way.

View of a Modern Tie-Treating Plant

Wood Preservation Deserves Greater Consideration*

Success of treatment depends on proper handling of wood in every step from seasoning to design of structure in which used

By DR. HERMANN VON SCHRENK
Consulting Timber Engineer, St. Louis, Mo.

WOOD depreciation and destruction may be classified under four general heads: (1) Weathering—meaning, thereby, the wearing away of exposed surfaces; (2) decay—which is always due to growth within the wood of fungi, and occasionally bacteria; (3) disintegration—due to the tunneling and direct consumption of the wood by such insects as termites and various boring insects, and marine borers, such as teredo, limnoria, etc.; and (4) fire.

The character of protection against these forces depends upon the kind of deterioration which is to be prevented. Painting the surfaces of wood is one of the simplest forms of protection, particularly against weathering. The ancients protected their boats against marine borer attack by sheathing them with some form of metal. However, the chief form of protecting wood against all depreciating factors is its impregnation, under pressure, with various chemicals. Suffice it to say in this regard that in 1903 there were 25 treating plants in the United States, whereas in 1930 there were 204 such plants.

Now and then someone still endeavors to protect timbers by painting them with a preservative. It may seem unnecessary, but I repeat, that painting with preservatives is simply wasting money, and should be strongly discouraged. Nothing but thorough penetration of all penetrable wood with an efficient preservative should ever be considered.

Experience has shown that long life will be obtained by using properly creosoted wood. The number of instances, both in this country and in Europe, where creosoted timbers have served 30 years or more, is growing from day to day. A recent study on the Big Four, where a definite record has been kept since 1905 of the number of ties inserted each year and of the number of ties of a particular year's insertion removed each subsequent year, shows that, to date, an average life of 26.6 years has been obtained from the ties laid in 1905. This group of ties was treated at a time when we knew little about the relation between the quality of wood and service, and relatively little about methods of handling and treating wood, the control of preservative, etc. Many ties were treated which were, doubtless, partially decayed, but in spite of this, they have given more than 2½ times the service of the white oak ties which were used earlier.

If there had been no mechanical destruction of the 1905 ties, the decay protection given them would have been, without question, sufficient to far exceed 30 years. If we consider creosoted bridges and study the records of life obtained from creosoted piles, sway braces, caps and stringers, we find that an even longer life than that mentioned for crossties has already been realized in a large number of cases, both abroad and in this country.

Many Factors Involved in Service Life

No satisfactory long-term service can be anticipated from wood without proper care and attention to all of the steps in its manufacture and preservation. Of equal importance is the matter of its subsequent application. I list the following factors for successful use: Quality of wood; proper preliminary preparation, such as seasoning; proper treatment; good chemicals; sufficient chemicals; physical protection against wounds after treatment; and manner of use. It is readily evident that the wood

*Abstract of a paper presented before the New York district meeting of the American Society for Testing Materials on November 17, 1932.

to be treated must be of prime quality, free from decay or other defects, and sufficiently strong for use untreated. In other words, a poor stick, chemically preserved, will be no better than an untreated stick.

Many years of experience have shown that the proper conditioning of wood before treatment is essential. Noth has been discovered which will produce better results than wood properly air-seasoned under controlled conditions. When timber has been properly selected and seasoned, it stands to reason that it should be treated by the most approved methods at plants where there is careful control and supervision over all stages of the process specified, including such factors as temperature, time and pressure.

One point which I wish to emphasize particularly in connection with creosoted materials is to be sure to use enough creosote, particularly when long-term service is essential. While the increased retention will, doubtless, increase the initial cost slightly, the ultimate life realization will be so materially increased that, from the standpoint of annual charges, the increased initial investment will become a very insignificant factor. One of the greatest sins in the use of creosoted material, committed in spite of repeated warnings on the part of national engineering bodies as well as of the wood preserving organizations, is the complete disregard of the injunction, "Never wound or cut material after it has been treated, except in cases of absolute necessity." He who wounds creosote piles without providing subsequent proper protection, has practically wasted the money used in treatment.

The factor of design in relation to use plays a particularly large role in the design of bridges and buildings. It is particularly pertient in connection with fire protection. I have in mind one bridge on which three fires have occurred within the last six years. Creosoted pine stringers were laid end to end in this bridge, from one end of the bridge to the other, leaving what amounted to a series of flues. Sparks from the wearing surfaces, working into small abrasions, ignited the creosoted stringers underneath and the fire was so intense that the heat warped the adjacent metal parts. Such a hazard could be controlled almost 100 per cent by placing fire stops at intervals to avoid the flue action. More care and attention should be paid to this question of design in the use of creosoted wood because, judging by reports of failures, there is a wide field for improvement.

Treated Wood Adaptable Generally

The mere fact that wood has been treated with chemicals does not in any way prevent its use in the way untreated wood could be used. When properly treated, preserved wood has practically the same strength as untreated wood and its nail-holding power, workability, ease of placement, etc., are equal to those of untreated wood. Timber preserved with any of the water soluble salts, such as zinc chloride, fluorides, corrosive sublimate, etc., can be painted as easily as untreated wood. Creosoted wood cannot be painted directly but methods have been developed whereby a protective coat of paint can be applied through which creosote will not penetrate and on which the desired final coats can be placed. The places where preserved wood can be used are, therefore, the same as for untreated wood, but with a very much wider field of usefulness.

Whenever a new structure is to be designed, there are two factors which naturally must be considered at the outset. One is the choice of material, namely, steel, stone, concrete, timber, etc., and the second is the cost. Any of the structural materials may fulfill the use requirements, but in order finally to settle the question, the cost must be considered. It is not sufficient to consider alone the first cost of the different materials, as is so frequently done. The capitalized cost, or the basis of annual charge, should always enter into the discussion.

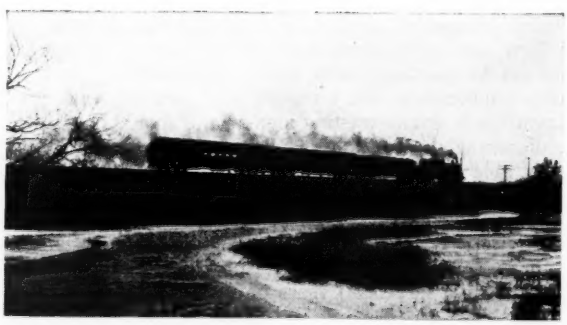
Changed Attitude and Understanding Needed

To most people, a piece of wood is a temporary affair which sooner or later will rot or be eaten by termites. At any rate, the idea is wide-spread that wood, at best, is a poor material for building purposes and that other building materials are much to be preferred. They forget the good qualities and think only of the defects. Even those familiar with treated wood have not fully grasped the fact of long life. A prominent engineer told me recently that if he bought stringers or caps with a preponderant amount of sapwood and then creosoted them, he would have to purchase larger timbers because the high percentage of sapwood would mean a weaker stick. This illustrates my thought. This engineer had not realized that sapwood is just as strong as heartwood, and that instead of having to get a bigger stick, he could probably have used a smaller stick if creosoted, because there would be no diminishing in size of the creosoted stick in the course of time, whereas in the case of the untreated stick he might very well have figured on an extra large piece to take care of depreciation during the period of service. This latter point is probably best illustrated by the practice of the telephone and telegraph companies, who now use creosoted poles that are smaller than the untreated poles they used previously.

Railway men manifest a similar frame of mind. They were in the habit of thinking that a certain number of ties per mile had to be removed, and many of them are still surprised at the decreasing number which have to be removed per mile as soon as the number of creosoted ties in track has become fairly large. They still think in terms of five to ten years of service and find it difficult to look at a creosoted tie and think 30 years.

A further fact in this frame of mind is the fallacy that it is necessary to buy the most expensive kind of wood, frequently all heart. Fortunately, this fallacy is being dissipated. The so-called "inferior" woods (using the word "inferior" as meaning shorter life) can frequently be chemically treated at a lower cost for the treated pieces than for the high-priced untreated pieces; and the service life of the treated pieces will far exceed that of the untreated pieces.

Well-treated timber is one of the longest lived materials available, and, while there is much to be learned concerning various details in wood preservation, the art has been advanced to a stage where no one need fear risking the use of treated wood. It has taken its place in the field of structural materials and should be considered whenever its qualities and cost warrant its use.



A Passenger Train on the Grand Trunk Western near Pontiac, Mich.

Steam Suburban Trains Have Given Way to Multiple Unit Electric Operation

Electrification and the Maintenance Department*

Chief engineer discusses the advantages and disadvantages of 3,000-volt overhead contact system in suburban territory

IN JANUARY, 1931, the Delaware, Lackawanna & Western completed the electrification of a part of its New York suburban zone, including its Morristown line and its Montclair and Passaic & Delaware branches, a total of approximately 161 track miles. In this work, the overhead catenary system, employing 3,000-volt direct current was used, and operation has been by multiple units of motor-driven cars and trailers. As anticipated, the electrification has been highly satisfactory and promises much in the future in the way of further developing the highly desirable suburban territory along our lines. This paper deals with the subject solely from the standpoint of the maintenance of way department work, pointing out what, in our short experience of about two years, appear to be the advantages and disadvantages of electrification such as ours.

Before discussing these advantages and disadvantages, it should be understood that our electrified lines are largely under passenger traffic, and that the motor cars which we use have axle loads of only about 37,000 lb., as compared with axle loads as high as 65,000 lb. in some of the steam equipment employed previously. Furthermore, no electric locomotives are operated on these lines and only a relatively few steam freight locomotives, the latter being used only in the handling of local freight traffic. Traffic conditions have not changed since electrification, except that the number of passenger trains has been increased during the non-rush hours.

Advantages

With these facts in mind, one will have a better understanding of the advantages and disadvantages pointed out in what follows. In the first place, since electrification, the number of train and engine movements in and about the terminals in the electrified zone has been reduced materially, and, at the present time, there are few or no movements of engines from roundhouses to trains or from trains to roundhouses. In fact, electric operation has made it possible to eliminate engine terminals at Montclair, South Orange, Summit, Morristown, Dover and Gladstone, N. J., and has greatly reduced the movements of engines into and out of our Hoboken terminal. These factors alone will save the expenditure of some money on the upkeep and repair of the tracks, buildings, turntables, etc., at these points.

By reducing the number of movements of steam locomotives, with their heavier axle loads, it has been found that the electrified tracks remain in surface and line better, and, therefore, require less maintenance. This, of course, must be due to the fact that the lighter axle loads of the motor cars do not depress the subgrade so much as the heavier loads of the old steam equipment. Furthermore, our electric equipment does not crowd the rails so much as steam locomotives with long, rigid wheelbases and heavy axle loads, and, as a result, it is easier for us to maintain gage on the sharper curves and through turnouts. This not only reduces regaging expenses, but also, in a measure at least, reduces the mechanical destruction of the crossties and switch timbers at such points.

Our electric equipment will pass safely around any curve and through any short turnout where an ordinary passenger car can be operated. In some of our terminals in the commuting district we have Nos. 6, 7 and 8 turnouts, at which locomotives with long wheel bases were frequently derailed. Thus far we have had no derailments of the electric equipment in these locations.

Since the completion of our electrification there has been only one instance where the rails have been burned by slipping driving wheels, and that occurred when electric operation was first begun. We are of the opinion, therefore, that damage to rails from this cause will be much less with electric equipment than was the case with steam equipment.

The operation of our electric units is much cleaner than our steam engines. As a result, the clogging of gutters and drains of station buildings has been elimi-

*A paper prepared by Geo. J. Ray, chief engineer of the Delaware, Lackawanna & Western for presentation before the October meeting of the Metropolitan Track Supervisors' Club at New York. As Mr. Ray was unable to attend the meeting at the last moment, the paper was read by A. A. Johnson, track engineer of the Lackawanna.

nated. The stone ballast in the vicinity of stations, on grades, and through our Bergen Hill tunnel does not become fouled with cinders, coal and sand, and this will result in a considerable saving in ballast cleaning. Our Bergen Hill tunnel, which is about seven-eights of a mile long, has much less gas, smoke and steam in it since electrification, which makes it not only more comfortable for passengers, but also more comfortable and safer for the men employed in the tunnel. Furthermore, by reducing the amount of gas, we believe it will reduce the corrosion of metal in the tunnel, which, heretofore, was considerable.

Disadvantages

Our electrification has not been without its disadvantages from a maintenance of way standpoint. The principal of these are as follows:

The energized wire of our catenary system is normally about 24 ft. above top of rail, but under bridges, in tunnels, etc., it is sometimes as low as 16 ft. As a result, in handling track material, cleaning cuts along the line, and other operations using derricks, there is danger of striking the energized wire with the booms. Much care must, therefore, be exercised to prevent personal injury or damage to the catenary system. To offset the danger in the operation of derricks, and to prevent, so far as possible, injury in case some operator should accidentally bring his boom into contact with the energized wire, our derrick booms have all been provided with insulated guard bars across their top ends, which, under most conditions, will prevent electrical contact between the energized wire and the booms.

When renewing turnouts and slip switches in busy locations and terminals, we have frequently, in the past, built up the new layouts and then set them in place in sections by means of derricks. In these locations the catenary system is usually low, which means that in the future derricks cannot be used in this work and that the turnouts and slips will have to be renewed by more expensive methods.

Of the 37,000-lb. axle loads of the new motor cars, there is an unsprung load on each axle of approximately 11,700 lbs. due to the combined weight of the truck and the motor on the axle. The motor wheels are 38 in. in diameter, and, because of the unsprung load and small wheels, a heavy hammer blow is struck on rigid frogs, drawbridge miter rails and on rail ends where there is considerable expansion allowance. This causes somewhat more batter than is experienced under steam operation.

The flange wear on curved rails, switch points and slip switches appears to be a little greater under electric operation than under steam operation. This can probably be overcome by the use of track oilers in the locations of heaviest wear.

The trolley wire from which power is taken to operate our electric trains is fixed and cannot be changed without considerable expense. Consequently, only limited changes can be made in curve super-elevation without destroying the contact between the trolley wire and the pantographs on top of the cars. If this contact should be destroyed, considerable damage would result to both the pantograph and the catenary system, in addition to causing delay to trains.

In our electrified system, insulated track joints cannot be staggered more than 59 in. due to signal circuits. This causes considerable cutting and boring of new rails when rail renewals are necessary, and slows up the renewal work a little at such locations. Having these joints so nearly opposite also makes it difficult to keep them in good line under traffic.

The operation of our electric equipment is very quiet as compared with steam equipment, and, as a result, we must employ additional watchmen in some locations to warn gangs of approaching trains, thus causing additional expense. Furthermore, since electrification, trains have been operated at more frequent intervals during non-rush-hour periods. This has resulted in a greater loss of time by our gangs during the working period of the day. In some locations the interval between trains is only 15 min., which leaves very little effective time for heavy out-of-face work.

Where the trolley wire is fastened to the under side of the overhead bridges and other structures, painting and other repairs are dangerous and more expensive unless the power is turned off. The power can, of course, be turned off, but this requires an electrician and frequently may be undesirable.

These are some of the disadvantages which we have encountered up to the present time. As time goes on, however, it is possible that appliances and methods of doing work can be improved to overcome these disadvantages entirely or in part.

Special Hook Simplifies Throwing Out Rails

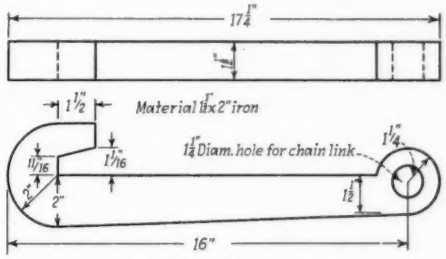
Close-up View of the Hook in Action, Showing the Perceptible Tilt Given to the Rail as it is Raised

THE lining out or throwing out of strings of old rails during rail laying operations where double-shoulder tie plates are used, has always been a rather awkward task unless both lines of rail-holding spikes are withdrawn, which is unusual. The difficulty arises through the fact that the rail cannot be slid sidewise, free of the plates, without first lifting it clear of the unspiked rail shoulders of successive plates, which cannot be effected easily unless the rail is tilted at the same time.

The usual manner of overcoming this difficulty and of affording a combination vertical and tilting lift to the rail has been to provide men with bars to tilt the rail inward or outward, as the case may be, to free it of the unspiked shoulders while a crane equipped with the usual type of rail tongs pulls it out in an upward sidewise direction. This method accomplishes the results desired, but has been superceded on the Lehigh Valley by a special rail-throwing-out hook which automatically tilts the rails sufficiently to clear the unspiked rail shoulders of the plates before there is any vertical rise or sidewise motion of the rail as a whole. With this hook, the rail is tilted and then raised entirely clear of the plates in one continuous operation, as simply as though a vertical lift alone was required.

The hook is a simple piece of bar iron, 17¼ in. long, as shown in the accompanying illustrations, which is designed to grasp the base of the rail (between ties) instead of the head. Passed under the rail, the hook end is fitted over the edge of the base on the side on

which the spikes have not been removed. When in this position, the opposite, or lifting end, which is provided with an eyelet to receive a chain link for attachment to the fall line of the crane, projects beyond the base on the opposite side, a distance of about 7¼ in. in the case of the Lehigh Valley 136-lb. rail. This arrangement puts the lifting point on the hook eccentric to the center of gravity of the rail by about 9¼ in., and, with the lift, causes the rail to tilt backward with respect to the fall line of the crane before there is any vertical or vertical-sidewise raising of the rail as a whole. As the lift increases, raising that part of the rail immediately each side of the hook, the tilting and lifting action on the rail progresses each way from the hook, ultimately freeing



Detailed Sketch of Hook for Throwing Out Rail

the rail from the plates over a considerable distance. Restrained by the action of that part of the rail that is not disturbed in the lift, the tilt of that part of the rail being raised does not exceed approximately 30 deg.

While especially effective in double-shoulder tie plate territory, the hook can also be used to considerable advantage in throwing out rails on single-shoulder plates. As will be readily understood, however, the hook is applicable only where the rails are taken out in strings. To set out individual rails after the joints have been broken in the track, as is sometimes advisable to avoid throwing the rails out on station platforms, highway crossings and bridges, the Lehigh Valley uses the usual type of rail tongs attached to a second crane line which is brought into action only when required.

Multi Plate Arch Installed to Replace Trestle

IN replacing a short timber trestle, the Toledo, Peoria & Western recently used an Armco Multi Plate corrugated metal arch, in an effort to provide the required waterway area with a limited headroom.

The trestle, which was located between Hamilton, Ill., and Warsaw, was a two-span structure 15 ft. long with a bent at the center and stone masonry abutments. The available headroom from the flow line of the stream to the base of the rail was nine feet and the problem was to select a drainage structure that would provide the maximum waterway area under the conditions imposed.

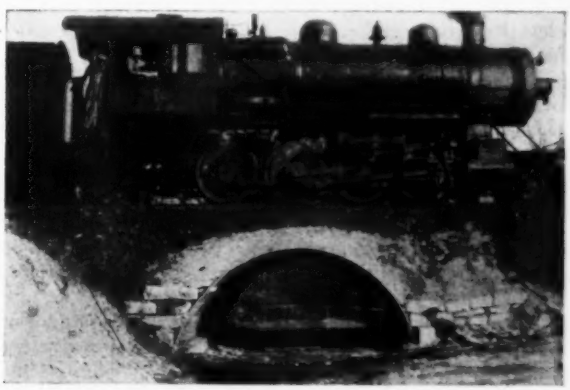
After considering various types of structures, the railroad decided to install a Multi-Plate arch having a span of 15 ft. and a height at the center of about 7½ ft. In addition to providing the necessary waterway area, such a structure offered certain advantages of erection and installation and obviated the necessity of disturbing the old abutments.

After the concrete footings for the arch had been poured just inside and adjacent to the abutments of the old structure, the erection of the arch was commenced. For this type of arch, corrugated plates, formed and punched for bolt holes, are delivered ready for erection in the field. In erecting the plates they are bolted together with longitudinal seams staggered to avoid the possibility of continuous seams around the circumference of the arch. The standard length of the plates is 10 ft.

Inserting the Remaining Plates After the Piles Were Removed

although 5-ft. lengths are used at the ends to compensate for the staggered arrangement of the 10-ft. plates.

With the exception of six of the plates, the entire structure was erected without disturbing the center bent of the trestle, the piles extending through an opening in the top of the arch. The center bent was then removed and the six remaining plates were bolted in place. The backfill consisted of pea gravel up to the bottoms of the



The Multi Plate Arch in Service

stringers, which were removed and the remaining distance filled with cinder ballast. The entire procedure of removing the center bent, applying the six plates and placing the backfill and ballast was done between trains and without the use of falsework.

This project was carried out under the direction of H. H. Best, master of bridges and buildings of the Toledo, Peoria & Western.

THE SLOWEST TRAIN—The doubtful distinction of having the slowest train in the world is enjoyed, it is believed, by Australia. The Australian train with the most snail-like tendencies is the "tea and sugar" special, which carries supplies from Port Augusta to Kalgoorlie and way points. Under its schedule, the train takes a week to travel the 1,051 miles and another week to make the return trip. Occasionally the train carries passengers, who probably are not of the impatient sort.

What's the Answer?

Have you a question you would like to have someone answer?

What is your answer for any of the questions listed in the box?

To Be Answered in March

1. What means can be employed to eliminate or minimize corrosion of track fastenings which are exposed to brine drippings, industrial fumes, or other unusual corrosive conditions?

2. Should the floors of waiting rooms and offices in frame passenger stations be insulated? Why? If so, what is the best method of doing so?

3. What is guard-rail gage? How was it established? How is it measured?

4. Where ice jams occur at pile trestles, what damage is likely to occur to the structures? What action can be taken to prevent it?

5. What causes rails in track to kink in surface? In line? What can be done to prevent this trouble? Can kinked rails be straightened and reused in main tracks?

6. Where a heavy deposit of ice forms on the interior surface of a water tank, what effect does warm weather have? What means can be employed to overcome this trouble?

7. What is the maximum thickness of shims that should be permitted in heaved track? If the heaving is greater than this amount, how should the track be surfaced?

8. What means, if any, can be employed to eliminate or minimize the deterioration of concrete in alkali waters or soils?

Lining Turnouts

What methods should be employed and what sequence should be followed in lining a turnout? Is there any advantage in the use of track liners for this purpose ?

Would Use String-Lining Method

By E. E. EDWARDS
Southern Pacific, Fields, Ore.

Owing to the speeds that are now permissible through turnouts and remembering that turnout curves have no elevation, it is obvious that too much emphasis cannot be placed on the importance of good line on the turnout side of a switch as well as on the main line. If switch ties are to be renewed, the best time to correct irregularities in the alignment is just prior to their installation, since by doing it at this time damage to the new ties by respiking will be avoided. If the switch is being put in new, it is obvious that the turnout rails should be spiked to line as they are laid.

There are three general methods that can be used in lining turnouts: (1) Lining by eye, (2) by offsets from the main track rail, and (3) by string-lining. The first of these is the old *unreliable* method, which frequently fails to produce the desired smooth-riding characteristics, especially through high-speed turnouts. The second method will give a correct, smooth-riding turnout curve when properly used. The third method, which I greatly prefer, is easy and quick of application and can be learned readily by any foreman with little effort, while any degree of refinement desired can be obtained with it without calling on the engineering corps for stakes.

In lining a switch, the first thing is to ascertain the condition of the main-line rails, since if any defect exists in the line of this track, it is best to pull the spikes on the lead rails and make the necessary shift in the main track. After this track has been restored to correct alinement, the turnout rails can be lined.

Switches must be kept in satisfactory line whether the section gang is large or small, and I have found that the use of track liners is of great advantage. In a large gang, they save an appreciable amount of time, while in many instances, small gangs are unable to do lining with bars. It is important that track liners be placed properly under the rail; the extra time consumed in digging out the ballast for proper placement will be more than compensated for in the shorter time required for lining and the better results that will be obtained. The track liners should be placed at an angle of about 45 deg. with the vertical so that it will be easy to lift the switch off its bed slightly; otherwise, it will be extremely difficult to shift.

After the main-track and turnout rails have been brought to proper line, the string-lining method may also be used for lining back of the frog, since the riding qualities of this curve may be as important as those of the turnout.

Track Liners Are a Distinct Advantage

By District Engineer

Keeping his turnouts in line should be considered one of the important duties of a section foreman. If this work is cared for properly, there is no reason in my experience why the lining of turnouts should be considered a major operation or why any unusual difficulties should be encountered in doing the work. If the lining is of a minor character, as it should be in ordinary maintenance, it can be done by eye. If the switch ties are

to be renewed, the main track, if on tangent, can be lined by eye. If the main track is on a curve, stakes should be set, or the string-lining method used.

On the other hand, if the main track and the turnout, either or both, require a relatively large shift to bring them to correct line, the spikes should be pulled in the turnout rails and the main-track rails lined, after which the turnout rails can be replaced in their proper position and spiked to line. The original lining by eye of a low-speed or infrequently-used turnout may be satisfactory but this method should never be permitted for high-speed turnouts where smooth riding is essential. In this case, the offset method seems to be the most exact, but extreme care should be exercised to insure that all measurements are made at right angles to the main-track rail.

Track liners are of great assistance in lining turnouts. Because of its weight and the length of the ties, a switch assembly is difficult to shift with lining bars and often cannot be budged unless the ballast is loosened in, or cleaned from, the cribs. Track liners reduce the effort required in lining and in most types of ballast are effective without the necessity of loosening the ballast. In making an original installation of a turnout, track liners are unnecessary. Since the ballast will be dug out, the main track can be lined easily with lining bars, while the turnout rails do not need to be lined with liners as they should be spiked to position as determined by the offsets.

▼ ▼ ▼

Anchoring Timber Trestles

When a timber trestle is built across a waterway where rock is too near the surface to permit the use of pile bents, what is the most satisfactory method of anchoring the mud sills against movement, to insure the safety of the structure

?

Would Anchor Sills Directly to Rock

By F. A. HOWARD
Engineer of Structures, Erie, Cleveland, Ohio

If natural rock is close to the surface and is fairly level, the bents can be placed directly on the rock, with such shimming as is necessary to make a level bearing. To eliminate the probability of movement, the sills can be held in place by means of dowels anchored in holes drilled into the rock. To provide this anchorage, the dowels should be grouted in.

On the other hand, if the natural rock is uneven, a satisfactory bearing can usually be provided by cutting it down. If this will be too expensive or require too much time, it can be leveled up with a low concrete pier, into which the dowels can be anchored.

Would Not Use Mud Sills

By C. S. HERITAGE
Bridge Engineer, Kansas City Southern, Kansas City, Mo.

Under the conditions cited, it has been my practice to use frame bents supported on small concrete piers or pedestals, the sills being secured against movement by means of bolts anchored into the concrete. In some cases I have placed the posts directly on the concrete without a timber cross sill. In this event, the posts must be anchored directly to the concrete. Another expedient where piling has been driven, but with insufficient penetration, is to excavate around the piling and embed them in a concrete encasement 2½ to 3 ft. high, 2½ to 3 ft. wide and extending the full width of the bent. This will prevent the piles from moving or pounding on the rock, while the encasing concrete can be used as a pier for supporting future frame bents when the piles are renewed.

I consider this treatment of the problem as more satisfactory than the use of the mud sills mentioned in the question. If timber mud sills are used, however, they should be set on a bed of grout or mortar to insure a level bearing. They should also be anchored into the rock. In some cases drift bolts will answer as anchors, but where the trestle is subject to heavy water pressure during freshets, the anchorage must be designed to resist uplift on the sills and mud sills.

There may be instances where the sills will be deep enough below the surface to insure against movement without anchorage. It is assumed, however, that where piles cannot be driven, rock is near the surface so that the anchorage is always a safeguard in case the soil or filling material is scoured out.

Prefers to Use Low Concrete Piers

By ROY HAHN
Clerk to Master Carpenter, Seaboard Air Line, Tampa, Fla.

It is my experience that for the conditions mentioned, the most satisfactory method is to construct concrete piers equipped with anchor bolts with which the sills can be held in place. Before depositing the concrete, the rock surface should be cleaned thoroughly. The piers should be about 2 ft. high, 8 to 12 in. wide at the top, 30 in. wide at the bottom and 15 ft. long. By using this form of construction, a smooth, stable bearing is provided for the sills, which has ample resistance against movement to insure the safety of the structure.

Recommends Drift Bolts Anchored in Rock

By C. C. WESTFALL
Engineer of Bridges, Illinois Central, Chicago

In considering this question, it is assumed that it refers to a situation where the water conditions make it undesirable to support frame bents on mud blocks as is ordinarily done where the soil is satisfactory and there is no danger of scour. If the distance from the surface of the ground to rock is five to seven feet, it will, in general, be desirable to excavate to rock and lay the sills directly on the rock, holding them in place by means of drift bolts anchored in holes drilled into the rock. If the rock surface is not suitable for this form of support, concrete piers can be constructed, only high enough to provide sufficient depth to avoid shattering, or they can be carried above the surface of the ground. This latter form of construction is preferable, since it permits the sills and bottoms of the posts to be placed in the open where they can be inspected easily.

Saving in Maintenance Will Pay for Footings

By G. M. HELMIG
Bridge and Building Department, Missouri Pacific, Wynne, Ark.

If the trestle is on a line that will not justify the cost of replacing it with a permanent structure, the most satisfactory solution of the problem as stated is to provide concrete footings which are anchored to the rock. They should be as wide at the top as the width of the sills to be used; the length will be determined by the height of the bents and the batter on the outer posts. The elevation of the top of the footings should be not less than one foot above the ground line.

Bolts should be set into the concrete at each end on

both sides of the footings, so that the batter posts can be anchored securely to the sills and to the footings by means of anchor straps on both sides. This will eliminate the use of drift bolts or dowels in the batter posts and sills, and will facilitate the replacement of the posts and sills when this becomes necessary. By locating the sills above ground and through the use of this form of anchorage, the saving in the cost of inspection and maintenance, together with the reduction in the loss from decay, which is usually rapid where timber is buried or partly buried in the soil, will soon offset the cost of the concrete footings.

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Maintenance of Passing Sidings

To what relative standard, as compared to main-line tracks, should passing sidings be maintained ?

Maintenance Should Be to a High Standard

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

This is a question which should interest operating officers as much as it does maintenance officers. The day has gone by, particularly on lines of heavy traffic, when light or badly worn rail, a deficiency in the number or quality of ties, inferior ballast and a lack of the proper amount of labor can be tolerated with respect to passing sidings. Heavy motive power, long trains of heavily loaded cars and higher speeds for both passenger and freight trains are bringing demands on passing sidings that require a higher standard of maintenance than was considered necessary as recently as 10 years ago. Not infrequently passenger trains are detoured through sidings to run them around heavier and longer freight trains at speeds which require a high order of track maintenance.

Passing sidings on busy lines should have good ballast, though not necessarily the same kind as on the adjacent main track, and plenty of it. They should be laid with heavy rail, not less than 100 lb. in section, of good quality, fully tie plated, and the ties, while they do not need to be of the same grade as main track ties, should not be inferior in quality. Gage should always be standard, and the line and surface should be maintained as nearly to main-line standards as is practicable. Ballast should be kept clear of vegetation, and locomotive cinders and rubbish kept cleaned away for the sake of appearance as well as for safety.

Depends on Speed Through Sidings

By L. A. RAPE

Section Foreman, Baltimore & Ohio, Renfrew, Pa.

In the main, this will depend on the speeds that are maintained through the sidings. In the last few years, many passing sidings have been equipped with remotely-controlled power switches and long turnouts and are used at high speeds. For instance, it is not uncommon for a high speed train to be run through a siding for the purpose of running around a slower train. Obviously, such a siding must be maintained to a high standard, perhaps to the same standard as the main-line tracks. In general, however, a lighter construction is suitable, that is, lighter rail and less ballast, since the siding is seldom required to carry the same volume of traffic. With respect to details involving safety, such as gage, line, surface, quality of ties, etc., there should be no difference in the standards to which the two tracks should be maintained.

Sidings on multiple-track lines and on lines of light traffic are generally used less frequently and the speeds of operation over them are much reduced. In this case, also, the features which affect safety must receive the same attention as on main-line tracks. Often, however, such sidings do not require the application of more than 10 per cent of the amount of labor that is given to an equal length of main track. It is a good rule to keep sidings safe for speeds a little higher than the limit calls for, because an occasional train may be expected to exceed this limit. Furthermore, since the timetable is no criterion as to the amount of use a siding may receive, I believe that no standard for passing siding maintenance should be more than 25 per cent below that for the main tracks.

Should Be Maintained in Serviceable Condition

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

Passing sidings should always be maintained in serviceable condition. By this I mean that the maintenance should correspond with the use that is made of the siding. In the great majority of cases the material used on passing as well as other sidings is inferior to that in use on the adjacent main tracks, so that it is next to impossible to maintain them to main-line standards. While there may be a relatively few high-speed sidings, the typical passing siding serves low-speed movements which seldom exceed 20 miles an hour. For this reason, a slightly irregular surface or an occasional low joint does no harm. Bolts should be kept tight. Ties should be in good condition, but need not be of the same grade as those in the main line. Good drainage is as essential for a passing siding as for a main-line track. Side tracks should be well policed, for weeds or rubbish on a siding mar the appearance of both the siding and the main line.

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Building Inspections

What are the advantages of an annual inspection of buildings? By whom should it be made? Should it be made in the fall or in the spring? Why ?

Many Advantages Are Enumerated

By G. A. BELDEN

Architect, Central of Georgia, Savannah, Ga.

No operation can be efficient unless it is systematized. The frequency of replacement of or extensive repairs to the various parts of a building will depend almost entirely on the stage of deterioration which is permitted before maintenance work is undertaken. The annual loss through laxity in maintenance is made up largely of early replacement and extensive repair costs that could have been avoided by a systematic program of maintenance.

A consistent system of periodic inspection is the initial step in the carrying out of such a program. These inspections should be made at intervals of not less than one year, and should be made quarterly if practicable by some one who is thoroughly familiar with all phases of building construction. The results should be reported on forms prepared in such detail that if all questions on the form are answered the condition of all of the important items subject to periodic deterioration will be

noted. When these forms are checked by the officer in charge of maintenance, they may indicate to him conditions that will require further detailed inspection before the proper and most economical maintenance program can be prepared.

Where annual inspections only are practicable, it seems that a fall inspection will be of greater benefit than one made in the spring, especially in northern areas. An inspection at this time frequently discloses conditions which, if allowed to continue through the winter, might seriously damage the building or equipment. Furthermore, if the inspection is made in the fall, it can be made the basis for the budget for the ensuing year. It is assumed that greater emphasis will be laid on the inspection of important shop and terminal structures, where lack of periodic maintenance might result in expensive renewals or heavy damage to the buildings and their contents.

Another advantage is the value of these inspections from the standpoint of fire prevention. Conditions are frequently disclosed which present unnecessary fire hazards that can be corrected at small expense, with a consequent reduction in the fire risk and possibly a reduction in fire insurance premiums.

In those sections of the country where buildings are subject to damage by termites, periodic inspections may reveal the presence of these insects before the building has been damaged seriously. This will permit methods of protection or extermination to be applied that may save heavy replacement costs.

Sees No Advantage in Annual Inspection

By ROY HAHN

Clerk to Master Carpenter, Seaboard Air Line, Tampa, Fla.

I see no advantage in annual building inspections except as a basis for preparing a budget or for ordering materials in advance to insure that the stores department will have the required stock on hand. It is my experience that it is practically impossible to plan a definite program for even a single month and be sure that it will be carried out. This is particularly true at this time when allotments are so sharply curtailed that emergency work occupies a large part of the time of the small forces available. If an annual inspection is to be made, however, it should be made by the master carpenter in the fall, in connection with the fall bridge inspection. In this way, a list of all materials required to carry out the year's program can be included in the budget.

Is the Basis for any Definite Program

By A. T. HAWK

Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

Annual inspections should be made the basis for a definite program of maintenance for the following year. At the time an inspection is made, sufficient information should be recorded, to enable reliable estimates to be made and the work programmed systematically through the months of the year. In this way, the monthly maintenance allowance can be arranged for intelligently in advance. This inspection will develop the total amount of repair work that will be necessary, and the relative importance of the various jobs. Lacking such an inspection, maintenance officers work in the dark and are quite likely to neglect important work while doing other work that could be deferred for the time being, particularly if allowances are somewhat restricted.

Inspections should be by divisions and should be made by the general building inspector, the division engineer and the master carpenter. This should be done in the early spring so that the necessary work, including roofing, painting, sheet metal work, heating, plumbing, etc., can be arranged for and completed during the summer and early fall. This will permit the buildings to enter the winter in first class condition and thus they will not be subject to undue deterioration.

Annual inspections often disclose items of work which, if neglected, will later require emergency action and add greatly to the cost. If there are seasons when the business carried on in a building is heavier than at other times, the repairs should be made during the period of least activity.

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Heating Pumping Stations

What provisions should be made for heating pumping stations that are operated automatically or at infrequent intervals? What type of heating plant is most satisfactory ?

Continuity of Heating Is Necessary

By Supervisor of Water Service

Heat is necessary in pump houses whenever the temperature drops below freezing, to prevent damage to the pumps, pipe lines and other equipment. In automatically-operated pumping stations and those where pumping is done infrequently, the problem of providing arrangements for continuity of heating is often difficult of solution because attendance is intermittent and infrequent at plants of both types. Stoves or other similar devices which must be given regular and frequent attention are seldom satisfactory because of this requirement and the fact that the attendance that is available may not be entirely dependable.

Automatic plants are operated electrically, which makes it possible to use electric heaters. Their use should be considered with caution, however, because the power cost is usually high. To reduce this to a minimum, the room should be as small as practicable and the ceiling should be lowered temporarily if not permanently.

Of late, automatic oil burners have been developed which are well adapted for heating where attendance is limited. It is important, however, to make the installation in such a manner as to insure elimination of fire risk, and to have ample oil storage to insure continuity of the heating, if for any reason the attendance fails temporarily.

In any system of heating, the matter of insulation should receive serious consideration, not only to reduce the cost of the heating, but also to insure retention of the heat as long as possible in case of failure of the heating equipment. Every pump house so heated should also have a weather-tight storm vestibule, the inner and outer doors of which should never be opened at once.

Many Factors Affect This Problem

By C. R. KNOWLES

Superintendent Water Service, Illinois Central, Chicago

So many factors affect this problem, even at individual stations, that only general statements can be made in a discussion of this question. The different methods of heating can be summarized as steam, stoves, electricity and oil. Under certain conditions, the natural heat of the earth can be utilized.

Steam heat is used chiefly at points where the pumping

station is located conveniently for drawing on a power plant or central heating plant as, for example, at a shop or engine terminal. Stove heat, including all types of coal burners, is satisfactory to only a limited extent, and its efficiency depends on the type of stove or furnace and the character of the fuel. Where bituminous coal is used, it is difficult to maintain a fire for more than a few hours at a time, so that it is necessary to use anthracite or coke if the fire is given attention at less frequent intervals. With a properly designed furnace burning anthracite, it should be possible to maintain a fire for periods up to 12 hr.

Electric heating is sometimes used where power current is available. It is very convenient, the cost of installation is small and the heat can be controlled automatically and dependably. The cost of current is high in most cases, however, so that careful consideration should be given to this cost, the space to be heated and the provisions that can be made for insulating the building. In rare cases the heat generated by the motors is sufficient to keep the temperature of the pump room above freezing.

Modern oil heaters with automatic control of the oil feed are well adapted for heating pumping stations. They require little attention, providing the heater and the oil storage are properly designed and installed. This type of heater can be designed to operate for 48 hr. or more without attention.

Where pumps are located even a few feet below the surface of the ground, the radiation from the natural heat of the earth is sufficient to prevent freezing, even at extremely low temperatures, if proper frost protection is given. To take advantage of the heat of the earth, however, the pumps should be at least 12 in. below the frost line. Features of importance equal to any method of heating are the design of the housing, provisions for insulation or frost protection, and drainage.

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Breakage of Angle Bars

What action, if any, can section forces take to eliminate or minimize the breakage of angle bars ?

Three Conditions Tend to Cause Breakage

By I. H. SCHRAM

Engineer Maintenance of Way, Erie, Jersey City, N. J.

In general, there are three conditions which tend to cause breakage of angle bars: Improper design; the practice of leaving ties unspaced, so that the joints are not given proper support; and improper maintenance. The latter cause will be considered in detail because of its importance at this time when maintenance appropriations are limited and must be utilized to give the greatest economy consistent with safety and to provide smooth-riding track.

Where angle bars are broken on high-speed, heavy-duty track, probably the most frequent cause is substandard ballast conditions. Such track is almost invariably ballasted with broken stone or comparable material. Where it becomes foul, it is likely to churn at the joints, causing excessive deflection in the track and broken angle bars. The best remedy is to clean the ballast. If this is not possible with the force available, the ballast should be dug down to subgrade at the ends of the ties, the water pocket should be opened and drained and the ballast should then be cleaned by hand screening and returned to place. The track can then be tamped, the bolts tightened and, if necessary, the track lined.

Loose bolts are a frequent cause of broken angle bars. The bars must fit properly if they are to support the rails and this can occur only when the bolts are kept tight. Excessive deflection as a result of loose bolts will cause broken angle bars, if permitted to continue long enough.

If anti-creepers are not properly maintained, thus allowing the track to creep, they may become a cause of broken angle bars, particularly if slot spiking is employed. Under these conditions, joint ties slue and the support for the joint is lost and may result in broken angle bars. The remedy is to keep the anti-creepers properly applied and in sufficient numbers to prevent the track from starting to creep. Improper surfacing, principally the raising of the joints high instead of tamping them to a level surface, is also a frequent cause of breakage.

No Breakage on Well-Maintained Track

By W. RAMBO

Roadmaster, Missouri Pacific, St. Louis, Mo.

Breakage of angle bars seldom occurs on well-maintained track. I have no hesitation in saying that broken angle bars are caused by poor maintenance. For this reason, the section forces can best eliminate or minimize this trouble by attention to the maintenance of their joints. To be specific, among the defects that cause broken angle bars are loose bolts and low joints. I mention these items together because if the bolts are loose, the joint is invariably low. Defective, decayed or improperly spaced ties that do not provide proper support for the joint are a fertile source of broken angle bars. To repeat, broken angle bars are rarely found on well-maintained track.

Good Maintenance Is Best Preventive

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

In making a study of this subject, there are a surprisingly large number of things that must be given consideration. If we are able to determine all of the basic causes of angle bar breakage, we shall then be able to improve our track maintenance to a marked degree. It is obvious, however, that space will not permit a discussion of all of the items involved or a full discussion of any of them. At present, however, it is only fair to say that we do not have the trouble with broken angle bars on the heavier rail sections that we do on the lighter sections.

Without going into too much detail or dwelling on specific items it suffices to say, that by keeping the bolts tight and well oiled to prevent corrosion and by making sure that the fishing surfaces are making proper contact, the section forces will eliminate one of the important causes of breakage. Clean ballast, well dressed and adequate drainage to keep the roadbed dry will also go far toward minimizing this trouble, but even with the best of ballast and drainage, the joints must be kept in good surface to insure against breakage.

A new factor has arisen lately with the increasing application of welding to the building up of rail joints. If proper protection is given the angle bars so that they do not become overheated, we probably will experience no trouble, but if this precaution is not taken, it may introduce a new factor into the situation.

As the rail sections decrease in size, the trouble with broken angle bars becomes more acute, but even here the general standard of maintenance has a most profound influence on the degree to which this trouble is experi-

enced. Low joints, defective joint ties, pumping joints, soft roadbed, wide expansion gaps, loose bolts, frozen joints, improperly designed bars and numerous other factors all have their influence on breakage. So far as the section forces are concerned, the whole situation can be summed up in a word. The better they maintain the track, the less broken angle bars they will have, whatever the weight of rail in service may be.

Do Not Let Joints Get Low

By A. A. MILLER

Engineer Maintenance of Way, Missouri Pacific, St. Louis, Mo.

Aside from the usual requirements that all track material be kept, or maintained, so far as practicable, in the condition called for under design and installation, one of the most important things is to prevent joints becoming low. Where joints are not maintained to a good surface, bars will become bent and there will be a slight dip in the surface of the rail at the joint. After a time, when such a joint is surfaced, there will be a tendency to straighten out the bar, and, as I see it, there will be a tendency for the bar to break from the top.

Section Forces Can Minimize, Not Eliminate

By M. H. MOSES

Section Foreman, Seaboard Air Line, Ragland, Ala.

Section forces can minimize but they cannot eliminate the breakage of angle bars. For one thing they can keep the bolts properly tightened and the fishing surfaces oiled at regular intervals to allow free movement in expansion and contraction, thus eliminating any strains on the joint that may be caused by thrust or pull as a result of temperature changes.

Furthermore, as a result of long experience, I believe that considerable breakage can be avoided by not placing any better grade of timber under the joint than is used back to the quarter, and by not tamping the joint ties any more solidly than the adjacent ties. If the opposite rule is followed, the joint does not settle as quickly or as much and, therefore, remains "cocked." Passing trains then depress the rail in the quarters more than at the joint and eventually the angle bars become deformed by being bent down at each end. Breakage then starts at the top of the bar near the middle and, once this has started, the angle bars must be taken out of service in a very short time. I hardly think it necessary to discuss the effect of low joints on the breakage of angle bars.

Discusses Causes of Breakage

By E. P. SAFFORD

Supervisor of Track, New York Central, Silver Creek, N. Y.

Most of the broken angle bars result from defective or neglected joint maintenance. The joint is allowed to get low and remain in this condition for a long time. It is thus subjected to severe vertical bending stresses. When the joint is raised, it is quite likely to be "cocked" a little. The passing wheels then tend to straighten out the bar, thus causing a reversal of stresses. Anyone can break a small wire quickly by bending it back and forth. The same thing happens to the angle bar. The only way to reduce the number of broken angle bars is to maintain a higher standard of joint surface.

There is another cause for broken angle bars which cannot be so easily remedied. This occurs when raising track. One or more joints ahead of the tampers are bar-tamped to the required surface. If a train approaches, it may be necessary to prepare a runoff hurriedly. In the hurry, the ties between the tampers and the next joint in advance will seldom be tamped as solidly as the "set up" joint, while the joint and adjacent ties in the runoff ahead of this joint may not get equally solid tamping. The result is that the angle bars will receive an unusual bending strain that may cause them to break at some future time.

These conditions are common to all types of joints and will cause breakage in all. Whether ordinary bolted joints, or joints with special bolt attachments designed to give spring to the bolts and freedom from freezing, are more subject to breakage, is not, as I understand it, a subject to be introduced into this discussion.

Result from Poor Joint Maintenance

By L. H. RAPE

Section Foreman, Baltimore & Ohio, Renfrew, Pa.

Where the joints are maintained to a good surface and the bolts are kept tight, broken angle bars do not occur. They are almost invariably the result of poor joint maintenance. When joints have been allowed to get low and remain in this condition for some time, it is reasonably certain that the angle bars will receive a permanent set. Later, the section forces surface the track or pick up the joints, cocking them with the purpose of straightening the bars. There is no surer way of starting the incipient cracks which eventually develop into full breaks, while in some cases a clean break occurs at once. The practice of cocking joints to straighten angle bars should be absolutely prohibited. If an angle bar is deformed as a result of a low joint, it should be replaced by a new or reformed bar.

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Classifying Released Rail

Into how many classifications should released rail be separated? Why and for what purpose ?

Four Classifications Required

By H. W. McLEOD

Principal Assistant Engineer, Canadian Pacific, Winnipeg, Man.

On the Canadian Pacific Lines West, it is our practice to classify the rails that are to be replaced, before they are removed from the track. This is done by a "marking" crew which consists of a man in charge and two helpers. They walk over the track that is to be relaid, examine the rails and mark them on the base with white paint according to the following classifications: Main-line quality, 4 spots; branch-line quality, 3 spots; for sidings, 2 spots; and for treatment, 1 spot. It is assumed that there are no rails in the main track that should be classified as scrap. The rail for treatment is shipped to the rail yard where it is cropped, straightened or otherwise reclaimed.

Rails can be classified and marked more appropriately while they are still in the track. After release, they can then be loaded according to the classification and the distribution made directly from the point of the loading, thus saving unnecessary transportation costs. Our main tracks are classified into (1) main line, (2) secondary main line, (3) important branch line and (4) minor branch line. The rails that are classed as main-line and branch-line quality are shipped to the respective territories for which they are suitable.

The men who make the classification and mark the rail are attached to our rail yard, which is equipped with

a rail saw, an electric-driven rail straightener and other machines for reclaiming rail, and they are familiar with rail classification and experienced in the reclamation of second-hand rails, angle bars, anti-creepers, tie plates, etc., so that they are particularly well qualified for this work. The rail yard and the men marking the rails are under the immediate jurisdiction of the engineer maintenance of way, Lines West, who issues shipping directions for the released rails and angle bars, thus permitting these materials to be shipped immediately to the point of re-use.

Main and Secondary Classifications Required

By Engineer Maintenance of Way

Rails that are released from the main tracks should be given four primary classifications: (1) Rails that can be relaid in other main tracks without treatment; (2) rails that must be reconditioned by cropping, straightening, etc., before they are suitable for further use in main tracks; (3) side track rail, some of which may need reconditioning; and (4) scrap. Secondary classifications can then be made of grades (1) and (2) to segragate those rails that are suitable for (A) secondary main lines or tracks, (B) important branch lines; (C) unimportant branch lines and (D) important passing sidings. Only a limited amount of scrap may be expected in the rail released from important main tracks. This will usually consist of stock rails, rails from curves and occasional damaged rails.

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Linseed Oil

What are the relative merits of boiled and raw linseed oils for painting wood and steel surfaces ?

Both or Either Can Be Used to Advantage

By Master Painter

Linseed oil, as it is used in paints, may be either raw or boiled. Since the pigment is inert and is in effect only a filler, the paint dries as the vehicle dries. The oil does not evaporate as water does, however. The drying process is one of hardening as the oil absorbs oxygen from the air to produce a tough elastic film. Raw linseed oil in its natural state dries very slowly. For this reason, in the process of preparing it for use as an ingredient of paint, a drier must be added. This is done by heating the oil to a relatively low temperature in the presence of oxides, such as lead, manganese or cobalt. This tends to partly oxidize and thicken it, and to make it workable it must be thinned by the addition of turpentine or light petroleum products.

On the other hand, boiled linseed oil dries very quickly on the surface, but forms a skin which retards the drying of the remainder of the film. For this reason, the surface of the paint may be dry to the touch but very soft underneath. To remedy this, it is necessary to use a high percentage of pigment and brush it out into a thin film, allowing it to harden all of the way through before the next coat is applied. The addition of a small amount of finely ground litharge accelerates the drying of the paint film, while this addition to the interior coats increases the hardness and waterproofing quality of the paint, particularly where red lead is used as the pigment. Boiled linseed oil resists the action of moisture somewhat better than the raw oil does. The raw and boiled oils are sometimes mixed in the ratio of one part of boiled oil to one or two parts of raw oil.

Until recently, boiled linseed oil was made by heating the oil in an open kettle in the presence of a mixture of the oxides of lead and manganese, and maintaining a temperature of about 500 deg. F., for five or six hours. This process is now practically abandoned. Of late years, the practice has been adopted of heating a volume of the raw oil with these oxides or that of cobalt, as is done in the preparation of the commercial raw oil. This is then added, while hot, to three parts of untreated oil. The entire mixture is then heated by means of steam coils to a much lower temperature than in the open-kettle process. As a variation, to give body to the finished product, air is sometimes blown through the oil while it is being heated.

Boiled linseed oil dries with a high gloss. Since following coats adhere much better to a dull surface, this characteristic can be modified by the addition of turpentine as a thinner for all but the finishing coat, which should be glossy. Turpentine evaporates almost completely, leaving a hard film with practically no gloss.

Either May Be Used If Properly Handled

By J. J. LaBAT

Assistant Bridge and Building Foreman, Missouri Pacific, Wynne, Ark.

Either raw or boiled linseed oil may be used with white or red lead for painting exterior surfaces of metal or wood. As long as the linseed oil is pure and of good quality, it makes little difference which is used, so far as lasting qualities and service are concerned, provided the formulae for mixing the paint are adjusted to take the greatest advantage of the physical qualities of the oil that is to be used.

These qualities differ rather sharply. Boiled oil tends to surface dry more rapidly when used in paint, but the raw oil film dries throughout its full thickness much sooner than the boiled oil. Furthermore, the boiled oil does not require the addition of extra driers, while under certain conditions it may result in a paint that is of a heavier consistency. This may not be perceptible in the manipulation of the brush but it is a fact that probably accounts, in part at least, for the necessity of allowing more time to elapse between coats than if the raw oil had been used.

Raw Oil Gives a More Elastic Film

By HARRY J. BARKLEY

Bridge and Building Foreman, Illinois Central, Carbondale, Ill.

Boiled linseed oil is now generally used for both exterior and interior wood and steel surfaces because it dries more quickly. This is a particularly important matter where two coats are applied or where the painting is done at a low temperature, since it allows the work to proceed more rapidly. If a second coat is applied over one that is not perfectly dry, or as painters say, "still has a tack," the ultimate result will be an alligatored surface which will be inclined to peel.

While raw linseed oil dries more slowly, it provides a more elastic and enduring film, so that it is especially adapted for use with red lead which in itself acts as a drier. When paint is to be applied to a structure where the public must be guarded to prevent soiled clothing and inconvenience or where cinders or other dirt are likely to soil the freshly painted surface, the quicker the paint dries the better. If only one coat is to be applied, however, or the other objections to slow drying are not important, raw linseed oil is the ideal vehicle for the paint.

News of the Month . . .

More Rail Employees in October

The number of employees of Class I railroads as of the middle of October totalled 1,033,225, as compared with 1,010,440 in September, an increase of 22,785. The number for October also represented an increase of 36,908 employees over August. It was, however, a decrease of 192,174, or 15.68 per cent, below the number of employees in October, 1931.

Western Roads to Sell Mileage Books

Beginning February 1, railroads affiliated with the Transcontinental and Western Passenger Association will offer mileage books for the first time in more than 15 years, on the basis of prices amounting to a 25 per cent reduction in fares. One book, good for 3,000 miles and containing $108 in coupons, will sell for $81. It will be good on all lines in the territory west of Chicago, St. Louis, Mo., Memphis, Tenn., and New Orleans, La., as far as the Pacific Coast. Another book will be sold for use between the eastern points mentioned and Texas, east of New Mexico, Utah, Wyoming and Montana. This book, which will contain $72 worth of coupons, will be sold for $54 and will be good for 2,000 miles of travel.

Railway Officer Advocates Beer Bill

Testimony to the effect that legalization of beer might result in an increase of railway revenues amounting to from $80,000,000 to $100,000,000 a year was presented by Owen T. Cull, general freight agent of the Chicago, Milwaukee, St. Paul & Pacific, at a hearing before the Ways and Means committee of the House of Representatives on December 8 on bills proposing a modification of the Volstead Act. Mr. Cull estimated that the Milwaukee road would benefit immediately from the beer traffic to the extent of from $2,000,000 to $2,500,000 yearly, and that the railroads as a whole would derive traffic amounting to $50,000,000 a year, in addition to perhaps $30,000,000 a year more on the materials and equipment required to re-establish breweries.

October Net Income Equal to 1931

For October, 1932, the net railway operating income of the Class I railroads of the United States amounted to $63,839,317, as compared with a net operating income of $64,202,245 for the same month of 1931, the annual rate of return on the investment being 1.88 per cent in each case. Operating revenues for October amounted to $298,461,506, as compared with $363,185,762 in October, 1931, a decrease of 17.8 per cent. Operating expenses for October totaled $200,146,789, which was a decrease of 23.4 per cent as compared with the previous year. Compared with September the revenues for October increased $26,000,000.

Warns Rails to Respect Airways

"If the present trend is any indication of the future of air travel, the railroads would do well to regard this agency with more respect," read a report of the Security Owners' Association, which embraces every phase of the development of this new industry. The membership of the Security Owners' Association consists of persons whose funds are devoted to railroad development. The report pointed out that the air lines in 1931 performed service "equivalent to 117,740,000 railway passenger miles, with a revenue loss to the railroads equivalent to 2.5 per cent of net income after fixed charges," and that the airways are not showing the effects of the current depression as are other common carriers.

Trucks Haul 5.5 Per Cent of Railroad Ton-Mileage

Intercity for-hire trucks and trailers in 1931 transported 245,775,000 tons of freight, with a total ton-mileage of 17,400,000,000, or 5.5 per cent, of the railway revenue ton-mileage for that year, according to an estimate included in the annual report of the secretary of commerce of the United States. The tonnage represents 15.3 per cent of the revenue tons carried by the Class I railroads during the year, although, because of the shorter average haul, it represents a much smaller percentage of the ton-mileage. According to this estimate, 200,000 of the 3,466,303 registered motor trucks were operated in intercity common and contract carrier service.

Roads Place Rail Orders

Orders for rail to fill 1933 requirements have been placed by several railroads in recent weeks. The Atchison, Topeka & Santa Fe has placed orders totalling 27,349 tons of rails as follows: The Colorado Fuel & Iron Company, 22,605 tons; the Bethlehem Steel Company, 1,908 tons; the Illinois Steel Company, 1,418 tons; and the Inland Steel Company, 1,418 tons. An order for 2,500 tons of rails has been divided between the Illinois Steel Company and the Inland Steel Company by the Illinois Central, while the Delaware & Hudson has placed an order for 3,000 tons of 130-lb. rail. Several months ago the Canadian National placed an order for 15,000 tons of rails with the Dominion Steel & Coal Corporation, Ltd., Montreal, Que., but only recently did it finish specifications for the rail, specifying 85-lb. and 100-lb. head-free rail.

Supreme Court Upholds Truck Law

Provisions of the Texas motor vehicle law providing for the regulation of contract motor carriers were upheld in a decision of the United States Supreme court rendered on December 5, affirming a decision of the district court for the Southern district of Texas denying an injunction sought by a number of contract carrier operators. The provisions in question were those providing that the rates of contract carriers be not less than those prescribed for common carriers and requiring contract carriers to obtain permits before instituting service in any territory, the issue of the permits to depend on whether the establishment of such service will impair the efficiency of existing common carriers operating in the same territory.

Railroad Attacks Recapture Clause

Injunction proceedings attacking the validity of the recapture clause of the Transportation Act of 1920, under which the government claims one-half of all railway earnings in excess of six per cent, were begun recently in the United States district court at Danville, Ill., when a suit filed by the Illinois Terminal Railroad was opened before Federal Judge Walter C. Lindley. In its complaint, the railroad asked the court to set aside an order of the Interstate Commerce Commission issued on September 6, 1932, requiring the railroad to pay the government $675,450, for excess profits from March 1, 1920, to December 31, 1924. The petitioners charged that payment of the sum would be tantamount to confiscation of their property and submitted in proof the earning statements of the years since 1929, showing losses.

Ask Continuation of Rate Increase

A continuance after March 31, 1933, of the temporary emergency surcharge increase in freight rates which the Interstate Commerce Commission authorized last year in the 15 per cent rate case, effective January 4, 1932, without the requirement that part of the revenue derived therefrom shall be pooled or paid over to needy carriers, is asked of the commission in a petition filed on December 10 by the Association of Railway Executives. During the past year the revenues derived from the surcharge have been turned over to the Railroad Credit Corporation for distribution to railroads failing to earn their interest charges. For the coming year the railroads estimate that "in no event likely to happen will the amount of the earnings of the roads which would be subject to be paid over for the use of other roads under the existing plan, be substantial enough to justify a continuance of the plan."

Association News

Metropolitan Track Supervisors' Club

About 60 members and guests were present at the meeting at New York, on December 15, at which time papers were presented by W. E. Gadd of the Rail Joint Company on Rail Joints, What They Are and How to Treat Them and by W. R. Hillary of the National Lock Washer Company, on Spring Washers or None. Both papers were favorably received and created considerable comment and discussion.

Railway Tie Association

President S. S. Watkins has appointed a committee to investigate and determine the possibility of adopting a standard or a flexible plan for adzing and boring crossties which will be acceptable to all or a majority of the railways. This committee includes W. J. Burton, assistant to chief engineer, M. P., chairman; W. H. Penfield, engineer maintenance of way, C. M. St. P. & P.; and Ed Kelly, Greenlee Bros. Co., Rockford, Ill.

Maintenance of Way Club of Chicago

Forty-six members and guests attended a meeting on Wednesday evening, December 21, when C. R. Knowles, who is in charge of work equipment on the Illinois Central, presented a paper with the title Making Work Equipment Work which was discussed actively by a number of those present. Preceding the reading of this paper, moving pictures depicting the use of tractors in levee construction, in various forms of maintenance of way work, and in handling snow, were presented through the courtesy of the Caterpillar Tractor Company.

American Railway Engineering Association

Reports from all except one of the standing and special committees of the association are now in the hands of the secretary and two bulletins have already been mailed. A third, Bulletin 351, is on the press and will be ready for mailing early in January. The report on outline of work and personnel of committees for the coming year is also in the printer's hands and will be ready for mailing in a short time.

Two committee meetings were held during December, the Committee on Iron and Steel structures having met at Urbana, Ill., on December 8 and 9, while the Committee on Economics of Railway Operation held a meeting in New York on December 15. On December 22, the Committee on Arrangements met in Chicago to take such preliminary steps as are necessary for the handling of the convention which is to be held at the Palmer House on March 14 and 15.

Several committees expect to hold meetings in January to plan their work on the assignments for next year, but as yet no definite dates have been announced.

The Nominating committee of the association has nominated the following candidates for office for the year beginning next March: President, W. P. Wiltsee, chief engineer, N. & W.; second vice-president, Robert H. Ford, assistant chief engineer, C. R. I. & P.; secretary, E. H. Fritch; treasurer, A. F. Blaess, chief engineer, I. C. In addition, J. E. Armstrong, assistant chief engineer, C. P. R., is automatically elevated from second vice-president to first vice-president.

Directors (three to be elected): Lem Adams, engineer maintenance of way, U. P.; E. H. Barnhart, assistant division engineer, B. & O.; W. F. Cummings, assistant chief engineer, B. & M.; G. S. Fanning, chief engineer, Erie; E. G. Hewson, engineer maintenance of way, C. N. R.; F. G. Jonah, chief engineer, St. L.-S. F.; W. H. Penfield, engineer maintenance of way, C. M. St. P. & P.; Dr. Hermann von Schrenk, consulting timber engineer; E. I. Rogers, president, P. & P. U.

Members of the Nominating committee (five to be elected): H. Austill, bridge engineer, M. & O.; E. W. Caruthers, assistant engineer, Penna.; H. R. Clarke, engineer maintenance of way, C. B. & Q.; R. L. Cochrane, chief clerk to chief engineer, A. T. & S. F.; J. H. Hande, accounting engineer, B. & O.; E. R. Lewis, principal assistant engineer, M. C.; C. H. Mottier, engineer of design, I. C.; F. L. Nicholson, chief engineer, N. S.; C. B. Stanton, professor of civil engineering, Carnegie Institute of Technology; J. R. Watt, engineer maintenance of way, L. & N.

The Wood-Preservers' Association

The following is the program for the twenty-ninth annual convention, which will be held at the Hotel Sherman, Chicago, on January 24-26:

Tuesday Morning, January 24
10:00 o'clock

Invocation
Minutes of Last Meeting
Address of Welcome
President's Address
Report of Secretary-Treasurer
Report of Committee 4—Preservatives
Report of Committee 5-5-1—Pressure Treatment of Poles

Tuesday Afternoon
2:00 o'clock

Report of Special Committee on Processing of Wood
Report of Special Committee on the Effect of Treatment on the Inflammability of Wood
Slow Combustion Tests—Paper by J. F. Harkom and J. I. Dore, Forest Products Laboratories of Canada
Experiments in Fireproofing Wood—Paper by T. R. Truax, R. H. Baechler and C. A. Harrison, Forest Products Laboratory
Toxicity of Creosote-Petroleum and Creosote-Coal Tar Mixtures—Address by Dr. Henry Schmitz, chief and professor of forestry, University of Minnesota, St. Paul, Minn.
Significance of Toxicity Determinations from a Practical Standpoint—Address by Dr. Hermann von Schrenk, consulting timber engineer, St. Louis, Mo.
The Training of Men for the Timber Preservation Industry—Address by Nelson C. Brown, dean, New York State College of Forestry, Syracuse, N. Y.
Report of Committee 5-2-1—Car Lumber

Tuesday Evening
7:30 P. M.

Joint meeting with the Western Society of Engineers of Chicago
Address on The Economic Value of Treated Timber Now and in the Future—Paper by Earl Stimson, chief engineer maintenance, Baltimore & Ohio

Wednesday Morning; January 25
9:00 o'clock
Users' Day

Report of Committee 7-1—Tie Service Records
Report of Committee 7-2—Bridge and Structural Timber
Report of Committee 7-7—Pole Service Records
Service Records of Treated Timber Bridges—Paper by Col. H. Austill, bridge engineer, Mobile & Ohio
The Economic Selection, Treatment and Use of Cross Ties—Paper by D. C. Curtis, chief purchasing officer, C. M. St. P. & P.
Treated Timber in Building Construction—Paper by Frank D. Chase, president Frank D. Chase, Inc., Architects and Engineers
The Successful Application of Treated Timber in Highway Structures—Paper by H. H. Houk, bridge engineer, State Highway Department of Alabama

Thursday Morning, January 26
9:00 o'clock

Report of Committee 6—Plant Operation
Report of Committee 7-10—Diversified Uses of Treated Wood
Report of Committee 5-5-2—Non-Pressure Treatment of Poles
Experiments with the Boulton Process in the Treatment of Green Southern Pine Poles—Paper by J. D. MacLean, Forest Products Laboratory
Report of Committee 7-4-1—Marine Piling Service Records
The Effect of High Temperatures on the Dimensions and Subsequent Shrinkage of Wet Wood—Paper by Arthur Koehler, Forest Products Laboratory
Decay in Buildings—Paper by Audrey C. Richards, Forest Products Laboratory
An International Termite Exposure Test—Paper by George M. Hunt, Forest Products Laboratory, and T. E. Snyder, U. S. Bureau of Entomology
Report of Service Bureau Board

Extend Period of R. F. C Loans

On December 8, President Hoover issued a proclamation extending for one year from January 22, 1933, the period during which the Reconstruction Finance Corporation may make loans under the provisions of Section 5 of the act creating the corporation, which is the section under which loans have been made to railroads, banks and financial houses.

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WORKS AND GENERAL OFFICES

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Personal Mention

General

Philip J. Watson, Jr., general superintendent of the Kansas City Terminal, Kansas City, Mo., who has spent most of his 25 years of service with various railways in engineering capacities, has been elected president and general manager, to succeed **William M. Corbett,** deceased. Mr. Watson entered railway service in 1903, as a rodman on the Pennsylvania and subsequently he served in the engineering departments of the Missouri Pacific, the Wheeling & Lake Erie and the Chicago & Alton.

Edward P. Bracken, executive vice-president of the Chicago, Burlington & Quincy, the Colorado & Southern and allied lines, and for 13 years a roadmaster on the Burlington, retired on January 1 after more than 45 years of service with this road. He first became associated with the Burlington in August, 1887, as a gang foreman on the Lincoln division, being appointed extra gang foreman on

Edward P. Bracken

the Wymore division in September, 1888. After serving in this position for a year, he was made a track foreman, which position he also held for a year, being then promoted to roadmaster, in which capacity he served for 13 years. At the end of this period, he was made trainmaster and in November, 1905, he was promoted to assistant superintendent of the Lincoln division. A year later, Mr. Bracken was further advanced to superintendent and served successively in this capacity on the Lincoln, Sterling, Sheridan, Brookfield and Galesburg divisions. He was promoted to general superintendent of the Wyoming district on May 15, 1909, and on February 1, 1910, was further advanced to the position of assistant general manager of the Lines East of the Missouri river, with headquarters at Chicago. He was promoted to general manager of the Lines East in August, 1912, and five years later, he was made operating vice-president. When the government took over control of the railroads during the war he was appointed federal manager of the Burlington. On the termination of government control in 1920, he was re-appointed vice-president in charge of operation, which position he held until his election as executive vice-president in September, 1931.

Engineering

O. N. Lackey, assistant division engineer of the Allegheny, Bradford and Meadville divisions of the Erie and of the Buffalo & Southwestern (a part of the Erie). with headquarters at Salamanca, N. Y., has been appointed acting division engineer with jurisdiction over the same territory and with the same headquarters, to succeed **C. M. Lewis,** who has been granted a year's leave of absence because of ill-health.

Frederick J. Taylor, district engineer on the Northern Pacific, with headquarters at St. Paul, Minn., has retired, effective January 1, after 46 years of continuous service with this road. Mr. Taylor was born on December 30, 1862, at West Chester, Pa., and was educated at Swarthmore college. He entered the service of the Northern Pacific in June, 1886, as a transitman and served in various positions in the engineering department until 1903, when he was appointed division engineer at Livingston, Mont. In 1919, Mr. Taylor was advanced to district engineer with the same headquarters, where he remained until 1930 when he was transferred to St. Paul.

J. V. McNab, division engineer on the Canadian Pacific, with headquarters at Saskatoon, Sask., has been promoted to district engineer of the Saskatchewan district, with headquarters at Moose Jaw, Sask., to succeed **J. R. C. Macredie,** deceased. **J. C. Chisholm,** division engineer on the Manitoba district, with headquarters at Kenora, Ont., has been transferred to Saskatoon to succeed Mr. McNab, and **C. D. MacKintosh,** assistant district engineer of the Manitoba district and division engineer of the Winnipeg terminals, with headquarters at Winnipeg, Man., has been appointed division engineer at Kenora to succeed Mr. Chisholm. **C. H. Scott,** engineer of water service, with headquarters at Winnipeg, has had his duties extended to include those of assistant district engineer of the Manitoba district and division engineer of the Winnipeg terminal.

Track

R. A. Brown has been appointed acting roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Fairbury, Neb., to replace **C. Kelley,** who has been granted a leave of absence. **T. W. Brown,** roadmaster, at Des Moines, Iowa, has had his headquarters changed to Allerton, Iowa.

C. W. Coil, trainmaster-roadmaster of the Fargo division of the Northern Pacific, with headquarters at Mandan, N. D., has been appointed division roadmaster of the Idaho division, with headquarters at Spokane, Wash. **H. J. McCall,** trainmaster on the Pasco division, has been appointed trainmaster-roadmaster at Mandan to succeed Mr. Coil.

Thomas Shea, general foreman in the maintenance of way department of the Canadian National, with headquarters at Halifax, N. S., has retired after 48 years of service with this railroad.

Bridge and Building

A. F. Ainslie, supervisor of bridges and buildings of the Pasco division of the Northern Pacific, has been appointed to the newly-created position of assistant supervisor of bridges and buildings of the Idaho division, with headquarters as before at Pasco, Wash., following the abolition of the Pasco division and its absorption by the Tacoma and Idaho divisions.

Obituary

W. F. Muff, roadmaster on the Middle division of the Atchison, Topeka & Santa Fe, with headquarters at Newton, Kan., died on December 2 at the company's hospital at Topeka, Kan.

E. L. Hawkins, inspector of bridges and buildings on the Southern Pacific Lines in Texas and Louisiana, with headquarters at Houston, Tex., was killed on December 11.

D. H. Howard, engineer of track elevation of the Chicago Rapid Transit Company, whose engineering career comprised many years of service with various railroads of the United States, died on December 21, at Lafayette, Ind.

George L. Mansfield, assistant engineer in the valuation department of the Chicago Great Western, with headquarters at Chicago, died suddenly on November 29. Mr. Mansfield had been connected with the engineering department of the Great Western for 17 years.

Joseph Pat Herd, who retired in 1931 as a roadmaster on the St. Louis-San Francisco, with headquarters at Carl Junction, Mo., died at his home at that place on November 5. At the time of his retirement Mr. Herd had been connected with the Frisco continuously for 54 years. He was born on June 18, 1861, at Paris, Tex., and entered the service of the Frisco on June 1, 1877, as a trackman at Richey, Mo. On March 2, 1881, he was promoted to section foreman and on March 16, 1882, he was further advanced to extra-gang foreman. Ten years later Mr. Herd was promoted to roadmaster, which position he continued to hold until his retirement on June 30, 1931.

L. C. Hartley, who retired in June, 1931, as chief engineer of the Chicago & Eastern Illinois, died on December 15 at Chicago. Mr. Hartley had spent 31 years in various positions in the signal and engineering departments of the C. & E. I. He was born on December 29, 1871, at Masontown, W. Va., and was educated at Ohio State University. His first rail-

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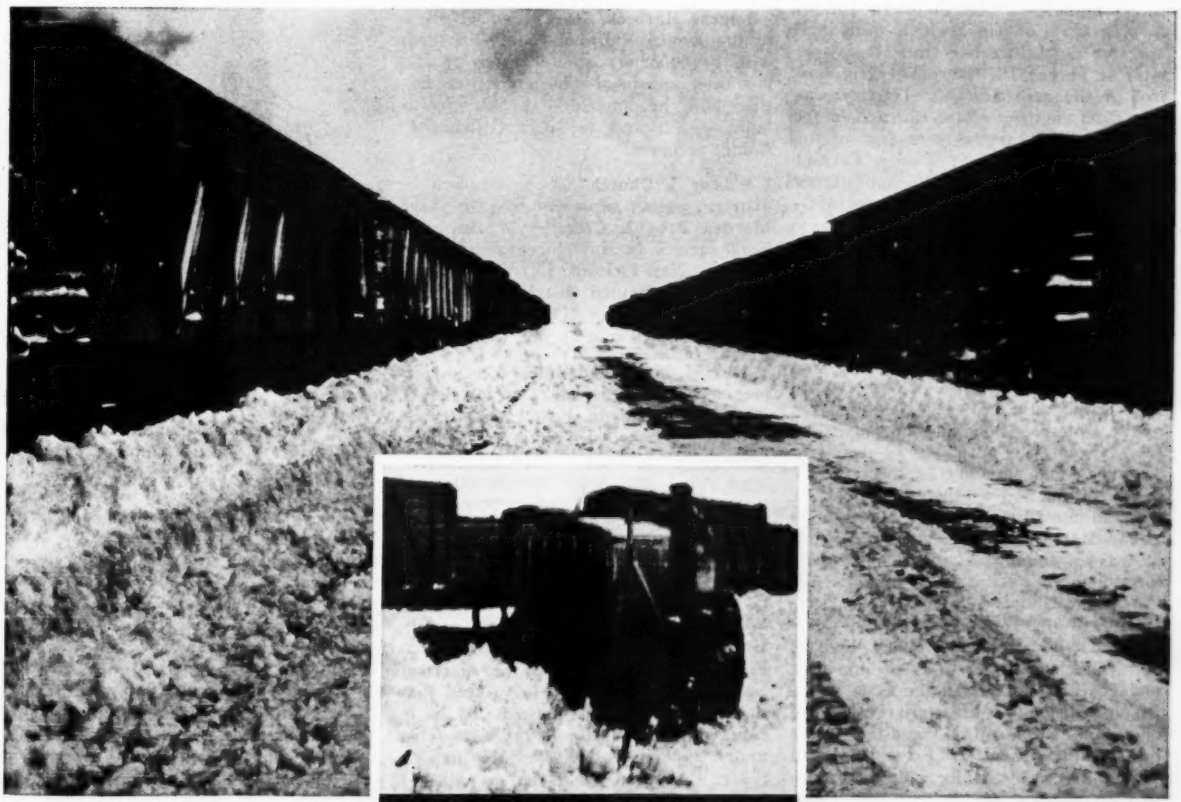

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way service was with the signal department of the Pittsburgh, Cincinnati, Chicago & St. Louis (now part of the Pennsylvania) in 1898. Two years later he left this company to go with the C. & E. I. as assistant on the engineering corps, being appointed assistant engineer in 1904. Three years later he was promoted to signal engineer and in 1910 he was further advanced to engineer maintenance

L. C. Hartley

of way. Mr. Hartley became chief engineer of the C. & E. I. in 1911, and held this position continuously until his retirement. From 1917 until his retirement, except during the period of federal control of the railroads, he served also as chief engineer of the Southern Illinois & Missouri Company, which owns and operates the bridge over the Mississippi river at Thebes, Ill. During federal control of the railroads, Mr. Hartley was also chief engineer of the Chicago, Terre Haute & Southeastern (now part of the Chicago, Milwaukee, St. Paul & Pacific) and of the Evansville & Indianapolis (now part of the Cleveland, Cincinnati, Chicago & St. Louis).

Oscar P. Chamberlain, president and general manager of the Chicago & Illinois Western until 1924, and formerly connected with the engineering departments of various railroads; was killed on December 10 at Chicago when he was struck by an automobile. Until recently Mr. Chamberlain had served as president of the Dolese & Shepard Company, Chicago. From 1889 until 1902 he served as a rodman and assistant engineer on the Pennsylvania and in the latter year he went to the Chicago Great Western as an assistant engineer. After two years he was appointed a division engineer on the Northern Pacific, then going to the Chicago & Illinois Western (then a subsidiary of the Dolese & Shepard Company), as chief engineer in 1905. In 1919, Mr. Chamberlain was elected president and general manager of the C. & I. W., which position he held until 1924, when operation of this railroad was taken over by the Illinois Central. From 1913 until shortly before his death, with the exception of a period during the World War when he was in the service of the United States Army, Mr. Chamberlain served the Dolese & Shepard Company, first as vice-president and general manager and then as president.

Supply Trade News

General

The American Rolling Mill Company, Middletown, Ohio, has acquired the properties of the **Lake Erie Steel & Blanking Company,** Cleveland, Ohio. **M. S. Phillips,** assistant to the general manager of sales of The American Rolling Mill Company, has been elected president and general manager of the Lake Erie Steel & Blanking Company.

Personal

Joseph E. Batchelder, who retired as vice-president of the Fairbanks-Morse Water Supply Company in 1931, died in Chicago of heart failure on December 12.

Walter Harnischfeger, vice-president of the **Harnischfeger Corporation,** Milwaukee, Wis., has been elected president and has been succeeded by **Donald B. Patterson,** general sales manager.

W. E. Crocombe, president of the **American Forge Company,** has also been elected president of the **American Manganese Steel Company,** Chicago Heights, Ill., to succeed **Wesley G. Nichols,** retired.

Eugene Harbeck, development engineer of the **Armco Railroad Sales Company,** with headquarters at Rochester, N. Y., has been appointed Chicago representative, with headquarters at 1122 Straus building, Chicago, to succeed **James F. Cohig,** resigned.

Walter J. Church has been appointed district sales representative of the **Morden Frog & Crossing Works,** with headquarters in the Queen & Crescent building, New Orleans, La. **T. F. Carlin** has been appointed district sales manager at Washington, D. C., with offices at 631 Pennsylvania avenue, N. W.

John M. Mulholand, until recently vice-president in charge of sales for the **O. F. Jordan Company,** East Chicago, Ind., has become associated with the **Youngstown Sheet & Tube Company,** Youngstown, Ohio, as special representative of railroad sales, with headquarters in the offices of the Youngstown Sheet & Tube Company at Chicago.

Charles F. Blackmer, vice-president at Cleveland, Ohio, of the **American Steel & Wire Company,** a subsidiary of the **United States Steel Corporation,** has been elected president of the American Steel & Wire Company, to succeed **John S. Keefe,** who has requested that he be relieved of his duties in order to retire under the corporation's pension plan.

Mr. Blackmer was born on April 1, 1878, at Worcester, Mass., and on July 1, 1898, he became an assistant in the laboratory of the Washburn & Moen Wire Company, Waukegan, Ill. When this company was taken over in 1899 by the American Steel & Wire Company, he served as a foreman in the tinning department of the Waukegan plant, continuing in that capacity after the latter company became a subsidiary of the United States Steel Corporation in 1900

Charles F. Blackmer

and in 1912 he was appointed assistant superintendent of the same plant. When the Minnesota Steel Company was projected as a subsidiary of the United States Steel Corporation, Mr. Blackmer was sent to Duluth, Minn., to design, build and put in operation its wire mills and on their completion in June, 1921, was made superintendent of those mills. In 1925, Mr. Blackmer was sent to Pitts-

John S. Keefe

burgh as district manager of the American Steel & Wire Company. He remained there until January, 1928, when he was appointed general superintendent of all wire mills of the company, with headquarters at Cleveland. In April, 1930, he became vice-president in charge of operation.

Mr. Keefe was born on January 24, 1864, at Boston, Mass. He moved to the midwest at an early age and when 13 became an office boy with the Chicago & North Western. He left the railroad in 1888 to become traffic manager for the Illinois Steel Company, now a part of the United States Steel Corporation. In 1899, he was made general traffic manager of the American Steel & Wire Company and in 1901 became a director and first vice-president of that company. He was elected president in December, 1927, which position he continued to hold until his retirement.

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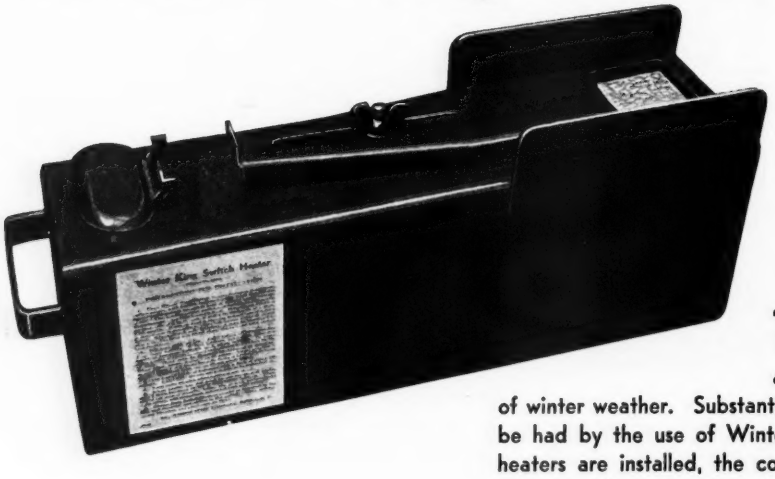

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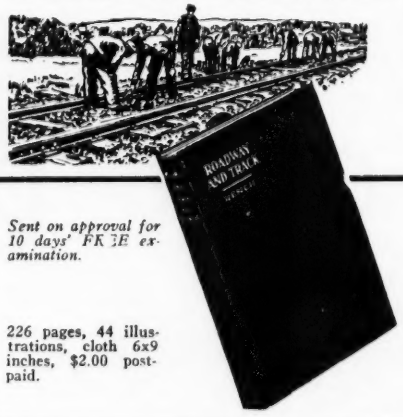

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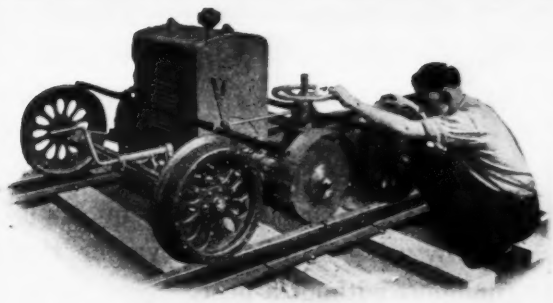

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Operated by 12 h.p., 4 cyl. gasoline engine, 1500 r.p.m. Ingenious hand crank starter makes it impossible to injure operator. Weight complete, 1200 lbs. In all other respects similar to Model P-2 Grinder.

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Rail-batter fails to shorten useful rail life where ends are built up by welding and finished off with Railway Track-work Grinders.

Shop accuracy on the track. Details? Gladly.

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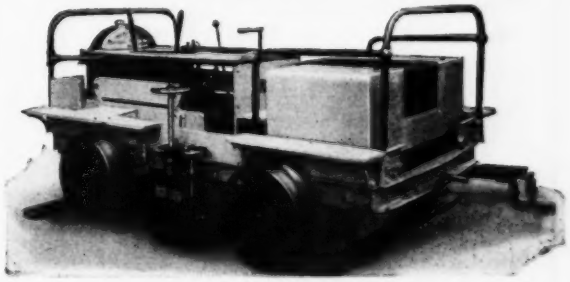

Railway Track-work Company Portable Reciprocating Grinder, Model P-7
Propelled and operated by 40 h.p. Ford Industrial gasoline engine. An economical machine for surfacing joints in new track. Grinds by reciprocation instead of rotation. Produces a smooth surface, maintains original rail contour, removes minimum metal. Two grinding blocks on each rail make 200 strokes per min. Quick derailing.

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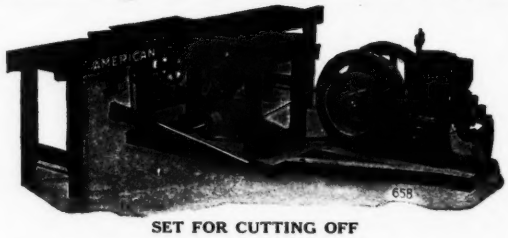

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ALPHABETICAL INDEX TO ADVERTISERS

A

American Saw Mill Machinery Co. 46
Armco Culvert Mfrs. Assn. 5

B

Bethlehem Steel Co. 44

C

Calcyanide Co. 46
Caterpillar Tractor Co. 41

D

Dearborn Chemical Co. 45

I

Industrial & Railroad Supply Co. 8

L

Lundie Engineering Corp. 3

N

National Aluminate Corp. 2
Nordberg Mfg. Co. 43

P

P. & M. Co. 1

R

Railway Track-work Co. 45
Ramapo Ajax Corp. 10

S

Simmons-Boardman Publishing Co. 44
Speno Railroad Ballast Cleaning Co., Inc., Frank 44
Standard Oil Co. (Indiana) 47

T

Timken Roller Bearing Co. 48
Toncan Culvert Mfrs. Assn. 7

W

Westinghouse Elect. & Mfg. Co. 4
Woodings Forge & Tool Co. 39

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LIQUID COATING ASPHALT

Liquid Coating Asphalt has many uses for moisture water proofing and corrosive protective coatings. It is used for coating roofs, steel and iron tanks, reservoirs and masonry of all types. It can be used under most all weather conditions, is easily applied and can be thinned down with naphtha.

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STANDARD OIL COMPANY
(INDIANA)
910 South Michigan Avenue Chicago, Illinois
112-B

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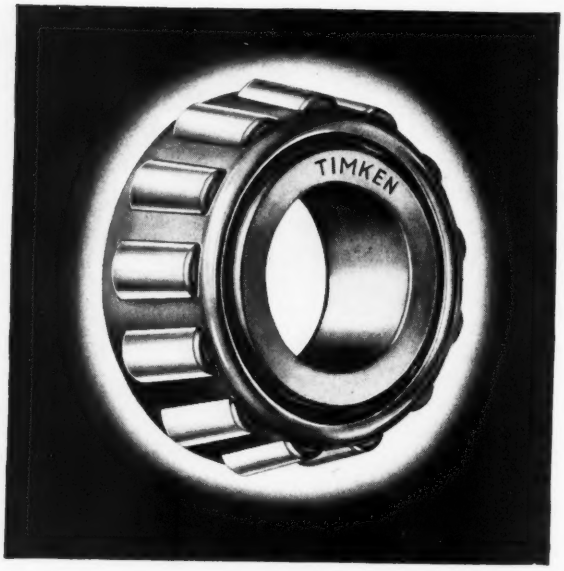

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You are in the market, let us say, for a machine tool, a motor rail car, or a power shovel.

Perhaps your choice has narrowed down to two or three makes which compare favorably in price and which seem to have equal ability. It is difficult for you to decide . . . *but*

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* Only with Timken Bearings can you get those extra years of dependable machine life, because only the Timken Bearing has the exclusive Timken combination of (1) Tapered construction (with ability to carry both thrust and radial loads) (2) Positively aligned rolls (which keep the bearing at maximum efficiency constantly) (3) Precision (assured by a factory where millions of dollars are invested in the most accurate gauges and machinery known to modern manufacturing science) and (4) Timken-made special alloy steel, created by Timken metallurgists, the most enduring and wear-resisting material ever developed for anti-friction bearings.

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